Due to changes of faculty members the list of modules and the content of modules is ocassionally modified.

This version is currently under revision but in most cases it can give you an impression about the content of the modules.

universitätbonn

Modulhandbuch

Masterstudiengang (M. Sc.)

“Plant Sciences”

Fassung April 2010

Studienverlaufsplan und Stundenplankonzept

Die Zuordnung der Module zu den Bereichen A-I kann der nachfolgenden Modulübersicht entnommen werden.

Ein typisches Studienkonzept sieht wie folgt aus:

Winter Term 1 (October-March)	Theory Modules choice A (Plant Biochemistry, Physiology and Molecular Botany) & B (Plant Cell Biology)	20 CP	30 CP
	Laboratory Module choice D (Plant Biochemistry, Physiology and Molecular Botany) & E (Plant Cell Biology)	10 CP	
Summer Term 1 (April-September)	Theory Module choice C (Plant Systematics, Biodiversity and Evolution)	7-12 CP	30 CP
	Laboratory Module choice F (Plant Systematics, Biodiversity and Evolution)	10 CP	
	D, E or F – further choice of modules	10 CP	
	G – Free choice modules	10 CP	
Winter Term 2 (October-March)	H – Internships / Lab Courses at external institutions	10 CP	30 CP
	D, E, F or G – Further choice of modules from	10 CP	
	H or I – External courses in plant or related sciences	12 CP	
Summer Term 2 (April-September)	Master Thesis	30 CP	30 CP
		120 CP	

Der gebundene Wahlpflichtbereich mit je einem Wahlpflichtmodul aus dem Theoriebereich A, B und C und je einem Wahlpflichtmodul aus dem Praxis-bereichen D, E und umfasst insgesamt 57 CP.
Der freie Wahlpflichtbereich umfasst mindestens 33 LP

Compulsory Theory Modules (one each in areas A and B)	2 x 10 CP	20 CP	Compulsory Choice 57 CP
Compulsory Theory Module (one in area C)	7 CP	7 CP	
Compulsory Practical Modules (one each in area D, E, F)	3 x 10 CP	30 CP	
Choice of Practical Modules from D, E, F or G	(0-4) x 10 CP	0-40 CP	Free Choice 33 CP
H: Internships, lab courses, practical courses at non-university external institutions (Industry, MPI et c.)		0-20 CP	
H: Any appropriate modules in Plant Sciences in accredited course programmes of the EU		0-10 CP	
I: Any appropriate modules in related natural sciences (e.g. Geo and Life sciences) in accredited course programmes of the EU		0-10 CP	
I: Any appropriate modules in other related sciences (e.g. economics, law) in accredited course programmes of the EU		0-6 CP	
Master Thesis		30 CP	30 CP
		120 CP	

Studienplanübersicht

semester term	3 lab course time frames (4-5 weeks)			after term time frame	credit points
1	*PCDU*^{obl}				10
	PBPM^{obl}				10
	PBDT				6
	PMSP	PHCH	PMSY	FREE1	10-20
	PPCB	PLPR	TRPL	PMEG	
		PBCO		ECPM	
		PSSF		PHPR	
		ICNE		PBEC	
		PLUL			
	regular credit points 1st term:				30-40
2	*PSBE*^{obl}				7
	PMEP				5
	PEPL	PNUT	PLPR	FREE1	10-30
	PMSP	PAPA	PEME	FREE2	
	PLDE	PBIO	PLCD	PMEG	
		MPMI	GAPB	PBEC	
		MCPB			
	CRPS				
	regular credit points 2nd term:				27-32
3	PBDT				6
	PMSP	PHCH	PMSY	FREE1	20-30
	PPCB	PLPR	TRPL	FREE2	
		PBCO		PMEG	
		PSSF		ECPM	
		ICNE		PHPR	
		PLUL		PBEC	
	CRPS				8
	regular credit points 3rd term:				28-38
4	Master thesis work				30
	Credit point total:				120+

- Colour coding indicates subject areas: Plant Cell Biology, Development and Ultrastructure (purple), Plant Biochemistry, Physiology and Molecular Biology (red) and Plant Systematics, Biodiversity and Evolution (green).
- One theory module for each subject area (italics: PCDU, PBPM, PSBE) and one freely chosen practical course module for each subject are obligatory.
- Any further modules of the three categories or additional modules (yellow) may be chosen freely only depending on time frame compatibility.

Hence, an exemplary student's module program may be, for example:
1st term: PCDU + PBPM + TRPL = 30 CP
2nd term: PSBE + PMEP + PEPL + MCPB = 32 CP
3rd term: CRPS + PLUL + PLPR = 28 CP
4th term: Master thesis = 30 CP
resulting in a total of: 120 CP (min. requirement)

Erläuterungen

- Die **Blockveranstaltungen** (Praxismodule) finden in einem von **8 Zeitfenstern (TF1-8)** statt, in die das Kalenderjahr aufgeteilt ist. Zeitfenster **TF1-3** von je max. 5 Wochen entsprechen in etwa dem klassischen Wintersemester**, TF5-7** in etwa dem klassischen Sommersemester**.** Die längeren Zeitfenster TF4 (8 Wochen) und TF8 (10 Wochen) liegen zwischen den klassischen Semestern.
- **Theoriemodule** mit semesterbegleitenden Vorlesungen und Seminaren in der Zeit vor 10 oder nach 17 h decken entweder **TF1-3** im Winter oder **TF5-7** im Sommer ab. Zusätzlich bleibt der Dienstagnachmittag frei von Blockveranstaltungen für weitere semesterbegleitende Veranstaltungen.
- **Laborkursmodule** können innerhalb eines Zeitfensters abgeschlossen werden. Dies fördert a) projektorientiertes, kontinuierliches Arbeiten in den Lebenswissenschaften, b) eine konfliktfreie zeitliche Planbarkeit und soll c) mittelfristig den nationalen und internationalen Lehraustausch in kurzen Zeiträumen befördern.
- Insbesondere die Zeitfenster TF4 und TF8 sind für externe oder frei vereinbarte Veranstaltungen (Laborkurse, Praktika, Internships) im Optionalbereich vorgesehen.
- Im folgenden **Stundenplankonzept** sind die Module des Masterstudiengangs Plant Sciences farbcodiert dargestellt:
  A&D – Plant Biochemistry, Physiology and Molecular Biology: Rot
  B&E – Plant Cell Biology and Development: Violett
  C&F – Plant Biodiversity, Evolution and Systematics: Grün.
  Die Anzahl zur Verfügung stehender Plätze ist angegeben, ggf. hinter dem ‚+' die Anzahl für den Masterstudiengang OEP-Biology vorgehaltener Plätze.

<table>
<tr><td colspan="2">WINTER TERM</td><td rowspan="11">Early October, INTRODUCTORY WEEK</td><td>Mo</td><td colspan="2">Di</td><td>Mi</td><td>Do</td><td>Fr</td><td rowspan="11">(Re-) examination Week</td><td rowspan="11">TF4
(mid Feb- mid Apr)

PLPR (6+2 pl.)
Plant Proteomics

PBEC (8+7 pl.)
Veget. Ecology

PBDT SEM

PHPR (6+6 pl.)
Phototr. Prokaryot.

(External)
Internships,
Practicals,
Lab Courses,
Excursons etc.
e.g.
PMEG (2 pl.)
Plant Mol. Eng.

ECPM (12 pl.)
Ecophys. Plant Metab.</td></tr>
<tr><td rowspan="2">“Lec time” (TF1 through TF3)</td><td>08h00-09h00</td><td></td><td colspan="2"></td><td></td><td></td><td></td></tr>
<tr><td>09h00-10h00</td><td>PCDU Lec</td><td colspan="2">PCDU Lec</td><td>PBPM Lec</td><td>PBPM Lec</td><td>PBPM Lec</td></tr>
<tr><td rowspan="6">“Lab time” 0-1 course of max. 5 weeks per TF</td><td rowspan="6">10h00-17h00</td><td colspan="2">TF1 (mid Oct - late Nov)</td><td colspan="2">TF2 (late Nov - X-mas)</td><td colspan="2">TF3 (New Year - mid Feb)</td></tr>
<tr><td colspan="2">PMSP (10+2 pl.)
Plant Mol. Str. Phys.</td><td colspan="2">PSSF (3+3 pl.)
Plant Surfaces</td><td colspan="2">PMSY (4+2 pl.)
Plant Molec. Syst.</td></tr>
<tr><td colspan="2">PPCB (12 pl.)
Plant Phys.+Cell Biol.</td><td colspan="2">PBCO (10+10 pl.)
Plant Biog.+ Cons.</td><td colspan="2">TRPL (12 pl.)
Transgen. Plants</td></tr>
<tr><td colspan="2"></td><td colspan="2">ICNE (24 pl.)
Crop Nutr. Environm.</td><td colspan="2">PBDT (15+15 pl.)
Plant Biodiv. Cons.</td></tr>
<tr><td colspan="2"></td><td colspan="2">PLUL (10 pl.)
Plant Ultrastructure</td><td colspan="2"></td></tr>
<tr><td colspan="2"></td><td colspan="2">PHCH (10 pl.)
Phytochemistry</td><td colspan="2"></td></tr>
<tr><td rowspan="2">“Sem time” (TF1 through TF3)</td><td rowspan="2">17h00-19h00</td><td>PCDU Lec</td><td>PBPM1 Sem

PBPM3 Sem</td><td>PCDU1,2,3 Sem</td><td>PBPM2 Sem

PBDT Lec</td><td></td></tr>
<tr><td>Mo</td><td>Di</td><td>Mi</td><td>Do</td><td>Fr</td></tr>
</table>

<table>
<tr><td colspan="2">SUMMER TERM</td><td>Mo</td><td>Di</td><td>Mi</td><td>Do</td><td>Fr</td><td rowspan="11">(Re-) examination Week</td><td rowspan="11">TF8
(late Jul – end Sep)

PBEC (8+7 pl.)
Veget. Ecology

(External) Internships,
Practicals,
Lab Courses,
Excursions etc.
e.g.
PMEG (2 pl.)
Plant Mol. Eng.</td></tr>
<tr><td rowspan="2">“Lec time” (TF5 through TF7)</td><td>08h00-09h00</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>09h00-10h00</td><td></td><td>PMEP Lec</td><td></td><td>PMEP Lec</td><td></td></tr>
<tr><td rowspan="5">“Lab time” 0-1 course of max. 5 weeks per TF</td><td rowspan="5">10h00-17h00</td><td colspan="2">TF5 (mid Apr - late May)</td><td colspan="2">TF6 (late May - mid June)</td><td>TF7 (mid June - late Jul)</td></tr>
<tr><td colspan="2">PEPL (6+6 pl.) Mol. Evol. Phylogen.</td><td colspan="2">PNUT (24 pl.) Phys. Nutr. Transloc.</td><td>PEME (12 pl.) Plant Env. Mol. Ecol.</td></tr>
<tr><td colspan="2">PMSP (10+2 pl.) Plant Mol. Str. Phys.</td><td colspan="2">MCPB (12 pl.) Mol. Cell. Phys. Biot.</td><td>PLPR (6+2 pl.) Plant Proteomics</td></tr>
<tr><td colspan="2">PLDE (10 pl.) Plant Development</td><td colspan="2">PBIO (10+5 pl.) Syst. Biol.Seed Pl.</td><td>PLCD (6 pl.) Plant Cell Dynamics</td></tr>
<tr><td colspan="2"></td><td colspan="2">MPMI (12 pl.) Plant-Microbe-Int.</td><td>GAPB (6+6 pl.) Genom. Anal. Pl. Br.</td></tr>
<tr><td></td><td></td><td colspan="2"></td><td colspan="2">PAPA (6+6 pl.) Paleobotany</td><td></td></tr>
<tr><td rowspan="2">“Sem time” (TF5 through TF7)</td><td rowspan="2">17h00-19h00</td><td></td><td></td><td>PSBE1,23 Sem</td><td>PSBE Lec</td><td></td></tr>
<tr><td>Mo</td><td>Di</td><td>Mi</td><td>Do</td><td>Fr</td></tr>
</table>

Modulübersicht und Modulhandbuch

Eine Übersicht der Module (ohne Einbeziehung externer Angebote aber mit der Angabe von Zulassungsvoraussetzungen, Prüfungsvoraussetzungen und -form) ist auch Anlage der Prüfungsordnung. In der folgenden Übersicht sind als zusätzliche Informationen Modulverantwortliche/beteiligte, Institute, Verteilung auf Winter- und Sommerhalbjahr sowie vorgehaltene Plätze (in Klammern für weitere bediente Studiengänge) enthalten:

#	Module Catalogue M.Sc. PLANT SCIENCES LEC=Lecture, SEM=Seminar, LAB=Lab Course/Excursion, INT=LAB+LEC+SEM	Module Coordinator	Insitute	Credit Points (CP)	Summer (S), Winter (W) or out of terms (O)	places
A: Obligatory Choice Theory Modules – Plant Biochemistry, Physiology and Molecular Biology (one)						
PBPM1	LEC: Plant Biochemistry, Physiology and Molecular Biology + SEM: Plant Biotechnology	Bartels (Knoop, Schreiber)	IMBIO	10	W	15
PBPM2	LEC: Plant Biochemistry, Physiology and Molecular Biology + SEM: Transgenic Plant Research	Knoop (Bartels, Schreiber)	IZMB	10	W	15
PBPM3	LEC: Plant Biochemistry, Physiology and Molecular Biology + SEM: Phytochemistry	Schreiber (Bartels, Knoop)	IZMB	10	W	15
B: Obligatory Choice Theory Modules – Plant Cell Development and Ultrastructure (one)						
PCDU1	LEC: Plant Cell Development and Ultrastructure + SEM: Plant Ultrastructure	Menzel (Baluška, Voigt)	IZMB	10	W	15
PCDU2	LEC: Plant Cell Development and Ultrastructure + SEM: Plant Development	Baluška (Menzel, Voigt)	IZMB	10	W	15
PCDU3	LEC: Plant Cell Development and Ultrastructure + SEM: Plant Cell Dynamics	Voigt (Baluška, Menzel)	IZMB	10	W	15
C: Obligatory Choice Theory Modules – Plant Systematics, Biodiversity and Evolution (one)						
PSBE1	LEC: Plant Systematics and Biodiversity + SEM: Plant Biodiversity	Barthlott m. N.N.	NEES	7	S	12 (+6)
PSBE2	LEC: Plant Systematics and Biodiversity + SEM: Molecular Systematics	Barthlott (Quandt, Mutke, Lobin)	NEES	7	S	12 (+6)
PSBE3	LEC: Plant Systematics and Biodiversity + SEM: Biodiversity and Conservation	Barthlott (Quandt, Mutke, Lobin)	NEES	7	S	12 (+6)
D: Obligatory Choice Lab Modules – Plant Biochemistry, Physiology, Molecular Biology (at least one)						
PLPR	LAB: Plant Proteomics	Bartels m. Röhrig	IMBIO	10	W, S	8
PMSP	LAB: Plant Molecular Stress Physiology	Bartels m. N.N.	IMBIO	10	W, S	10 (+2)
PHCH	LAB: Phytochemistry	Schreiber	IZMB	10	W	10
TRPL	LAB: Transgenic Plants	Knoop	IZMB	10	W	12
MCPB	LAB: Molecular Cell Physiology & Biotechnology	Dörmann	IMBIO	10	S	12
E: Obligatory Choice Lab Modules – Plant Cell Biology and Development (at least one)						
PLCD	LAB: Plant Cell Dynamics	Voigt	IZMB	10	S	6
PLUL	LAB: Plant Ultrastructure	Menzel	IZMB	10	W	8
PLDE	LAB: Plant Development	Baluška	IZMB	10	S	10
PPCB	LAB: Plant Physiology and Cell Biology	Dörmann	IMBIO	10	W	12

F: Obligatory Choice Modules – Plant Biodiversity, Evolution and Systematics (at least one)						
PEPL	INT: Molecular Evolution and Phylogeny	Knoop	IZMB	10	S	6 (+6)
PMSY	LAB: Plant Molecular Systematics	Quandt	NEES	10	W	4 (+2)
PBCO	LAB: Plant Biogeography & Conservation	Barthlott m. Mutke	NEES	10	W	10 (+10)
PBIO	LAB: Systematics and Biology of Seed Plants	Barthlott m. NN	NEES	10	S	10 (+5)
PAPA	INT: Paleobotany & Palynology	Litt	IfP	10	S	10 (+5)
G: Free Choice Modules at Bonn University						
PNUT (MA-P-08)	INT: Physiology of Nutrient uptake and translocation	Goldbach m. Mitarb.	INRES	6	S	24
ICNE (MA-P-06)	INT: Interactions between crop nutrition and the environment	Goldbach m. Mitarb.	INRES	6	W	24
GAPB (MA-P-33)	INT: Genome analysis in plant breeding	Leon m. Pillen	INRES	6	S	6 (+6)
PEME	INT: Plant & Environment Molecular Ecology	Schreiber	IZMB	10	S	6 (+6)
PMEP	LEC + SEM: Plant Molecular Evolution and Phylogeny	Knoop	IZMB	5	S	8 (+8)
PBDT	LEC: Vegetation Geography + SEM: Biodiversity & Conservation	Barthlott m. Mutke	NEES	7	W	15 (+15)
PBEC	LAB: Vegetation Ecology (incl. Excursion)	Barthlott / N.N.	NEES	10	S	8 (+7)
PSSF	INT: Plant Surfaces: Structure & Function	Barthlott m. NN	NEES	10	W	2 (+4)
MPMI	INT: Molecular Plant Microbe Interactions	Ülker	IZMB	10	S	6
PMEG	INT: Plant Molecular Engeneering	Ülker	IZMB	10	W, S	2
PHPR	INT: Phototrophic Prokaryotes	Dahl m. N.N.	IFMB	10	W	6 (+6)
CRPS	LEC: Colloquium Reports in the Plant Sciences	N.N.	IZMB	8	W,S	30
H: External Free Choice Modules in the Plant Sciences (regularly or on individual agreement)						
ECPM	INT: Ecophysiology of plant meta-bolism: photosynthesis and growth	Rascher, Walter, Schurr	ICG Jülich	5	O (TF4)	12
FREE1	Practical lab research, courses or internships agreed upon on an individual basis with plant research groups in university or external research institutions.			Max. 12 CP	Any TF	
FREE2	Any appropriate modules in Plant Sciences which are part of an accredited course program at a university within the EU.			Max. 12 CP	Any TF	
I: External Free Choice Modules in other sciences						
FREE3	Any appropriate modules in related natural sciences (e.g. Geo Sciences, Biochemistry, Pharmacology et c.), which are part of an accredited course program at a EU university.			Max. 10 CP	Any TF	
FREE4	Any appropriate modules in other related sciences (e.g. Economics, Law et c.), which are part of an accredited course program at a EU university upon application.			Max. 10 CP	Any TF	

Plant Biochemistry, Physiology and Molecular Biology 1				universitätbonn
Modulnummer **PBPM1**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **WS**
Modulbeauftragter	Prof. Dr. Dorothea Bartels			
Anbietende Lehreinheit(en)	FG Biologie, IMBIO			
Beteiligte Dozenten	Prof. Dr. Dorothea Bartels Prof. Dr. Volker Knoop Prof. Dr. Lukas Schreiber			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	1

Lernziele	Students should gain a solid understanding of the physiological processes in plants on the basis of a well-founded, current knowledge of the molecular structures, reactions and processes in plant cells and tissues.
Schlüsselkompetenzen	Searching, reading and understanding of scientific literature and databases. Skills for visual and oral presentation of scientific data. Advanced understanding of plant molecular biochemistry, biology, genetics and physiology.
Inhalte	The lecture will address all major topics of plant biochemistry, physiology and molecular biology including: biochemical pathways of primary and secondary metabolism, photosynthesis, respiratory chain, carbohydrates, plant hormones, membrane and storage lipids, membranes, long-distance and membrane transport, cell wall biosynthesis and external biopolymers, nitrogen and sulfur assimilation, abiotic and biotic environmental interactions, physiological stress, plant-microbe interactions and plant pathogens, plant genomes and gene expression, model organisms in plant research, gene technology and transgenic plants. The accompanying seminar will demonstrate the scientific impact of the vast amount of new information on gene sequence and expression data as well as on protein and metabolite data. This information which has been gathered over the last two decades has had a major effect on the understanding of plant metabolism and physiology. Examples will be discussed using very recent literature.

PBPM1	**Plant Biochemistry, Physiology and Molecular Biology 1**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lecture - Plant Biochemistry, Physiology and Molecular Biology (60) Seminar - Plant Biotechnology (15)	3 2	210 90	7 3
Prüfung(en)		benotet/unbenotet		
	Written examination (3 Hours) Oral presentation (30 min)	Graded (70%) Graded (30%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lecture and seminar	benotet/unbenotet		
Sonstiges	Recommended Reading Bob B. Buchanan, Wilhelm Gruissem, and Russel L. Jones. Biochemistry and Molecular Biology of Plants, Rockville, MD:American Society of Plant Physiologists, 2000. Taiz L, Zeiger E (2006) Plant Physiology. Sinauer Associates Inc., Sunderland, MA			

Plant Biochemistry, Physiology and Molecular Biology 2				universitätbonn
Modulnummer **PBPM2**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **WS**
Modulbeauftragter	Prof. Dr. Volker Knoop			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	Prof. Dr. Dorothea Bartels Prof. Dr. Volker Knoop Prof. Dr. Lukas Schreiber			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	1

Lernziele	Students should gain a solid understanding of the physiological processes in plants on the basis of a well-founded, current knowledge of the molecular structures, reactions and processes in plant cells and tissues.
Schlüsselkompetenzen	Searching, reading and understanding of scientific literature and databases. Skills for visual and oral presentation of scientific data. Advanced understanding of plant molecular biochemistry, biology, genetics and physiology.
Inhalte	The lecture will address all major topics of plant biochemistry, physiology and molecular biology including: biochemical pathways of primary and secondary metabolism, photosynthesis, respiratory chain, carbohydrates, plant hormones, membrane and storage lipids, membranes, long-distance and membrane transport, cell wall biosynthesis and external biopolymers, nitrogen and sulfur assimilation, abiotic and biotic environmental interactions, physiological stress, plant-microbe interactions and plant pathogens, plant genomes and gene expression, model organisms in plant research, gene technology and transgenic plants. The accomanying specific seminar on transgenic plants in PBPM2 will focus on up-to-date literature on new developments in basic and applied research using transgenic plant approaches.

PBPM2	**Plant Biochemistry, Physiology and Molecular Biology 2**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lecture - Plant Biochemistry, Physiology and Molecular Biology (60) Seminar - Transgenic Plant Research (15)	3 2	210 90	7 3
Prüfung(en)		benotet/unbenotet		
	Written examination (3 Hours) Oral presentation (30 min)	Graded (70%) Graded (30%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lecture and seminar	benotet/unbenotet		
Sonstiges	Recommended Reading Bob B. Buchanan, Wilhelm Gruissem, and Russel L. Jones. Biochemistry and Molecular Biology of Plants, Rockville, MD:American Society of Plant Physiologists, 2000. Taiz L, Zeiger E (2006) Plant Physiology. Sinauer Associates Inc., Sunderland, MA			

Plant Biochemistry, Physiology and Molecular Biology 3				universitätbonn
Modulnummer **PBPM3**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **WS**
Modulbeauftragter	Prof. Dr. Lukas Schreiber			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	Prof. Dr. Dorothea Bartels Prof. Dr. Volker Knoop Prof. Dr. Lukas Schreiber			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	1

Lernziele	Students should gain a solid understanding of the physiological processes in plants on the basis of a well-founded, current knowledge of the molecular structures, reactions and processes in plant cells and tissues.
Schlüsselkompetenzen	Searching, reading and understanding of scientific literature and databases. Skills for visual and oral presentation of scientific data. Advanced understanding of plant molecular biochemistry, biology, genetics and physiology.
Inhalte	The lecture will address all major topics of plant biochemistry, physiology and molecular biology including: biochemical pathways of primary and secondary metabolism, photosynthesis, respiratory chain, carbohydrates, plant hormones, membrane and storage lipids, membranes, long-distance and membrane transport, cell wall biosynthesis and external biopolymers, nitrogen and sulfur assimilation, abiotic and biotic environmental interactions, physiological stress, plant-microbe interactions and plant pathogens, plant genomes and gene expression, model organisms in plant research, gene technology and transgenic plants. In the accompanying seminar "Phytochemistry" in PBPM3 recent publications in the field of primary and secondary plant metabolites will be presented and discussed.

PBPM3	**Plant Biochemistry, Physiology and Molecular Biology 3**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lecture - Plant Biochemistry, Physiology and Molecular Biology (60) Seminar - Phytochemistry (15)	3 2	210 90	7 3
Prüfung(en)		benotet/unbenotet		
	Written examination (3 Hours) Oral presentation (30 min)	Graded (70%) Graded (30 %)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lecture and seminar	benotet/unbenotet		
Sonstiges	Recommended Reading Bob B. Buchanan, Wilhelm Gruissem, and Russel L. Jones. Biochemistry and Molecular Biology of Plants, Rockville, MD:American Society of Plant Physiologists, 2000. Taiz L, Zeiger E (2006) Plant Physiology. Sinauer Associates Inc., Sunderland, MA			

Plant Cell Development and Ultrastructure 1				universitätbonn
Modulnummer **PCDU1**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **WS**
Modulbeauftragter	Prof. Dr. Diedrik Menzel			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	PD Dr. Frantisek Baluska Prof. Dr. Diedrik Menzel Dr. Boris Voigt			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	1

Lernziele	Students should be able to understand the fundamental principles of plant cell architecture, function, cell growth and dynamics, the genetic basis of plant development, and basic principles of communication between cells, tissues and organs. They should gain insight into the various strategies by which plants perceive and respond to all sorts of abiotic and biotic stimuli.
Schlüsselkompetenzen	Searching, reading and understanding of scientific literature and databases. Skills for visual and oral presentation of scientific data. Advanced understanding of plant cell biology and development.
Inhalte	The lecture will address structure, function and development of plant cells, tissues and organs from the level of microscopic anatomy to the level of macromolecular interactions. The lecture will include: endosymbiont theory and the emergence of plant cell lineages, plastid types, structure and function, endomembrane systems as a dynamically regulated machinery for the secretion of wall material and a means of cell-cell communication, interaction between the cytoskeleton the plasmamembrane and the structural framework of the cell wall to create polarity, maintain growth and accomplish cell differentiation, principles of the plant cell cycle, mitosis and cytokinesis, the role of programmed cell death in development and host pathogen interaction, mechanisms and regulation of material transport between cells, tissues and organs. The seminar will focus on new technical and conceptual approaches to understand plant ultrastructure on the basis of recent publications in the field.

PCDU1	**Plant Cell Development and Ultrastructure 1**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lecture - Plant Cell Development and Ultrastructure (60) Seminar - Plant Ultrastructure (15)	3 2	210 90	7 3
Prüfung(en)		benotet/unbenotet		
	Written examination Oral presentation (30 min)	Graded (70%) Graded (30%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lecture and seminar	benotet/unbenotet		
Sonstiges	Recommended Reading Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. Molecular biology of the cell, New York:Garland Science, 2002. Bob B. Buchanan, Wilhelm Gruissem, and Russel L. Jones. Biochemistry and Molecular Biology of Plants, Rockville, MD:American Society of Plant Physiologists, 2000. William V. Dashek. Methods in plant electron microscopy and cytochemistry, Humana Press, 2000. A. W. Robards. Dynamic aspects of plant ultrastructure, McGraw Hill, 1974.			

Plant Cell Development and Ultrastructure 2				universitätbonn
Modulnummer **PCDU2**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **WS**
Modulbeauftragter	PD Dr. Frantisek Baluska			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	PD Dr. Frantisek Baluska Prof. Dr. Diedrik Menzel Dr. Boris Voigt			
Verwendbarkeit des Moduls	Studiengang		Modus	Studiensemester
	M. Sc. Plant Sciences		Wahlpflicht	1
Lernziele	Students should be able to understand the fundamental principles of plant cell architecture, function, cell growth and dynamics, the genetic basis of plant development, and basic principles of communication between cells, tissues and organs. They should gain insight into the various strategies by which plants perceive and respond to all sorts of abiotic and biotic stimuli.			
Schlüsselkompetenzen	Searching, reading and understanding of scientific literature and databases. Skills for visual and oral presentation of scientific data. Advanced understanding of plant cell biology and development.			
Inhalte	The lecture will address structure, function and development of plant cells, tissues and organs from the level of microscopic anatomy to the level of macromolecular interactions. The lecture will include: endosymbiont theory and the emergence of plant cell lineages, plastid types, structure and function, endomembrane systems as a dynamically regulated machinery for the secretion of wall material and a means of cell-cell communication, interaction between the cytoskeleton the plasmamembrane and the structural framework of the cell wall to create polarity, maintain growth and accomplish cell differentiation, principles of the plant cell cycle, mitosis and cytokinesis, the role of programmed cell death in development and host pathogen interaction, mechanisms and regulation of material transport between cells, tissues and organs. The seminar will focus on the basic paradigms in plant development and the emergence of radically new concepts guiding our understanding of underlying molecular mechanisms.			

PCDU2	**Plant Cell Development and Ultrastructure 2**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lecture - Plant Cell Development and Ultrastructure (60) Seminar - Plant Development (15)	3 2	210 90	7 3
Prüfung(en)		benotet/unbenotet		
	Written examination Oral presentation (30 min)	Graded (70%) Graded (30%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lecture and seminar	benotet/unbenotet		
Sonstiges	Recommended Reading Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. Molecular biology of the cell, New York:Garland Science, 2002. Bob B. Buchanan, Wilhelm Gruissem, and Russel L. Jones. Biochemistry and Molecular Biology of Plants, Rockville, MD:American Society of Plant Physiologists, 2000.			

Plant Cell Development and Ultrastructure 3				universitätbonn
Modulnummer **PCDU3**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **WS**
Modulbeauftragter	Dr. Boris Voigt			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	PD Dr. Frantisek Baluska Prof. Dr. Diedrik Menzel Dr. Boris Voigt			
Verwendbarkeit des Moduls	Studiengang		Modus	Studiensemester
	M. Sc. Plant Sciences		Wahlpflicht	1
Lernziele	Students should be able to understand the fundamental principles of plant cell architecture, function, cell growth and dynamics, the genetic basis of plant development, and basic principles of communication between cells, tissues and organs. They should gain insight into the various strategies by which plants perceive and respond to all sorts of abiotic and biotic stimuli.			
Schlüsselkompetenzen	Searching, reading and understanding of scientific literature and databases. Skills for visual and oral presentation of scientific data. Advanced understanding of plant cell biology and development.			
Inhalte	The lecture will address structure, function and development of plant cells, tissues and organs from the level of microscopic anatomy to the level of macromolecular interactions. The lecture will include: endosymbiont theory and the emergence of plant cell lineages, plastid types, structure and function, endomembrane systems as a dynamically regulated machinery for the secretion of wall material and a means of cell-cell communication, interaction between the cytoskeleton the plasmamembrane and the structural framework of the cell wall to create polarity, maintain growth and accomplish cell differentiation, principles of the plant cell cycle, mitosis and cytokinesis, the role of programmed cell death in development and host pathogen interaction, mechanisms and regulation of material transport between cells, tissues and organs. The seminar will focus on dynamic behaviour of cell compartments with special focus on cytoskeleton, endocytosis, endomembranes and intracellular signalling as well as macromolecular interactions and regulatory circuits that govern cell growth and differentiation.			

PCDU3	**Plant Cell Development and Ultrastructure 3**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lecture - Plant Cell Development and Ultrastructure (60) Seminar - Plant Cell Dynamics (15)	3 2	210 90	7 3
Prüfung(en)		benotet/unbenotet		
	Written examination Oral presentation (30 min)	Graded (70%) Graded (30 %)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lecture and seminar	benotet/unbenotet		
Sonstiges	Recommended Reading Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. Molecular biology of the cell, New York:Garland Science, 2002. John Bowman. Arabidopsis: An atlas of morphology and development, Springer, 1994. Bob B. Buchanan, Wilhelm Gruissem, and Russel L. Jones. Biochemistry and Molecular Biology of Plants, Rockville, MD:American Society of Plant Physiologists, 2000. Barry W. Hicks. Green fluorescent protein: Applications and protocols, Humana Press, 2002. C. J. Staiger, F. Baluska, D. Volkmann, and P. Barlow. Actin: A dynamic framework of multiple plant cell functions, Kluwer, 2000.			

Plant Systematics, Biodiversity and Evolution 1				universitätbonn
Modulnummer **PSBE1**	Workload **210 h**	Umfang **7 CP**	Dauer Modul **1 Semester**	Turnus **SS**
Modulbeauftragter	Prof. Dr. Wilhelm Barthlott			
Anbietende Lehreinheit(en)	FG Biologie, Nees Institut			
Beteiligte Dozenten	Prof. Dr. Wilhelm Barthlott und Mitarbeiter			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	2
	M. Sc. OEP Biology	Wahlpflicht	2

Lernziele	At the end of the module students should have a sound overview about the major lineages and families of plants (especially vascular p.), their systematics, morphology, and basic ecology. They will have a good background in morphology, taxonomy, and systematics and have a first overview about the broader field of biodiversity research.
Schlüsselkompetenzen	Searching, reading and understanding of scientific literature and databases. Skills for visual and oral presentation of scientific data. Advanced understanding of plant biodiversity.
Inhalte	The lecture teaches the systematics, morphology and ecology of plants. It focuses especially on the systematics and evolution of vascular plants taking up recent insights from the field of molecular systematics. Vascular plants are the most important structural elements and primary producers in almost all non-aquatic ecosystems. They produce food, medicine, and technical products for the over 6 Billion people. The potential of biological structures and functions as models for technical applications in the field of biomimicry (german: "Bionik") is discussed. The lecture is accompanied by a seminar on plant biodiversity, including basic ecological and biogeographical questions.

PSBE1	**Plant Systematics, Biodiversity and Evolution 1**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lecture - Plant Systematics and Biodiversity (120) Seminar - Plant Biodiversity (18)	2 1	120 90	4 3
Prüfung(en)		benotet/unbenotet		
	Written examination Oral presentation (30 min)	Graded (70%) Graded (30%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lecture and seminar	benotet/unbenotet		
Sonstiges	Recommended Reading JUDD, W.S., CAMPBELL, C.S., KELLOG, E.A. & STEVENS, P.F. (2002): Plant Systematics. A phylogenetic approach. Sinauer Associates, Inc., Massachusetts (USA). KUBITZKI, K. (ed.) (1993 -): The families and genera of vascular plants. Several Volumes. - Springer; Heidelberg. SITTE, P., WEILER, E.W., KADEREIT, J.W., BRESINSKY, A., KÖRNER, C.: Strasburger Lehrbuch der Botanik. - G. Fischer; Stuttgart.			

Plant Systematics, Biodiversity and Evolution 2				universitätbonn
Modulnummer **PSBE2**	Workload **210 h**	Umfang **7 CP**	Dauer Modul **1 Semester**	Turnus **SS**
Modulbeauftragter	Prof. Dr. Wilhelm Barthlott			
Anbietende Lehreinheit(en)	FG Biologie, Nees Institut			
Beteiligte Dozenten	Prof. Dr. Dietmar Quandt Prof. Dr. Wilhelm Barthlott			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	2
	M. Sc. OEP Biology	Wahlpflicht	2

Lernziele	At the end of the module students should have a sound overview about the major lineages and families of plants (especially vascular p.) , their systematics, morphology, and basic ecology. They will have a good background in morphology, taxonomy, and systematics. Students will gain a fundamental understanding of molecular evolutionary processes governing the change of DNA, and the application of this information to phylogenetic and evolutionary analysis.
Schlüsselkompetenzen	Searching, reading and understanding of scientific literature and databases. Skills for visual and oral presentation of scientific data. Advanced understanding of plant biodiversity.
Inhalte	The lecture teaches the systematics, morphology and ecology of plants. It focuses on the systematics and evolution of vascular plants taking up recent insights from the field of molecular systematics. Vascular plants are the most important structural elements and primary producers in almost all non-aquatic ecosystems. They produce food, medicine, and technical products for the over 6 Billion people. The potential of biological structures and functions as models for technical applications in the field of biomimicry (german: "Bionik") is discussed. In the seminar major emphasis is put to provide an introduction to the rapidly developing methods in the field of molecular systematics, both in the laboratory and at the computer. Sources of information are presented from the sequence to the genome level.

PSBE2	**Plant Systematics, Biodiversity and Evolution 2**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lecture - Plant Systematics and Biodiversity (120) Seminar - Molecular Systematics (18)	2 1	120 90	4 3
Prüfung(en)		benotet/unbenotet		
	Written examination (3 Hours) Oral presentation (30 min)	Graded (70%) Graded (30%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lecture and seminar	benotet/unbenotet		
Sonstiges	Recommended Reading JUDD, W.S., CAMPBELL, C.S., KELLOG, E.A. & STEVENS, P.F. (2002): Plant Systematics. A phylogenetic approach. Sinauer Associates, Inc., Massachusetts (USA). KUBITZKI, K. (ed.) (1993 -): The families and genera of vascular plants. Several Volumes. - Springer; Heidelberg. SITTE, P., WEILER, E.W., KADEREIT, J.W., BRESINSKY, A., KÖRNER, C.: Strasburger Lehrbuch der Botanik. - G. Fischer; Stuttgart. D. Hillis, C. Moritz and B. Mable: Molecular Systematics. Sinauer. D. Soltis, P. Soltis and J Doyle: Molecular Systematics of Plants II (DNA Sequencing). Kluwer. K. Weising et al. DNA fingerprinting in plants and fungi R. Page & E. Holmes: Molecular Evolution - A Phylogenetic Approach. Blackwell.			

Plant Systematics, Biodiversity and Evolution 3				universitätbonn
Modulnummer **PSBE3**	Workload **210 h**	Umfang **7 CP**	Dauer Modul **1 Semester**	Turnus **SS**
Modulbeauftragter	Prof. Dr. Wilhelm Barthlott			
Anbietende Lehreinheit(en)	FG Biologie, Nees Institut			
Beteiligte Dozenten	Prof. Dr. Wilhelm Barthlott Dr. Jens Mutke			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	2
	M. Sc. OEP Biology	Wahlpflicht	2

Lernziele	At the end of the module students should have a sound overview about the major lineages and families of plants (especially vascular p.) , their systematics, morphology, and basic ecology. They will have a good background in morphology, taxonomy, and systematics and have a first overview about the field of conservation biology.
Schlüsselkompetenzen	Searching, reading and understanding of scientific literature and databases. Skills for visual and oral presentation of scientific data. Advanced understanding of plant biodiversity.
Inhalte	The lecture teaches the systematics, morphology and ecology of plants. It focuses on the systematics and evolution of vascular plants taking up recent insights from the field of molecular systematics. Vascular plants are the most important structural elements and primary producers in almost all non-aquatic ecosystems. They produce food, medicine, and technical products for the over 6 Billion people. The potential of biological structures and functions as models for technical applications in the field of biomimicry (german: "Bionik") is discussed. Aspects of biodiversity conservation are discussed within the seminar.

PSBE3	**Plant Systematics, Biodiversity and Evolution 3**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lecture - Plant Systematics and Biodiversity (120) Seminar - Biodiversity and Conservation (18)	2 1	120 90	4 3
Prüfung(en)		benotet/unbenotet		
	Written exam Oral presentation (30 min)	Graded (70%) Graded (30%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lecture and seminar	benotet/unbenotet		
Sonstiges	Recommended Reading JUDD, W.S., CAMPBELL, C.S., KELLOG, E.A. & STEVENS, P.F. (2002): Plant Systematics. A phylogenetic approach. Sinauer Associates, Inc., Massachusetts (USA). KUBITZKI, K. (ed.) (1993 -): The families and genera of vascular plants. Several Volumes. - Springer; Heidelberg. PRIMACK: Essentials of Conservation Biology.Sinauer. SITTE, P., WEILER, E.W., KADEREIT, J.W., BRESINSKY, A., KÖRNER, C.: Strasburger Lehrbuch der Botanik. - G. Fischer; Stuttgart.			

Plant Proteomics				universitätbonn
Modulnummer **PLPR**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **WS & SS**
Modulbeauftragter	Prof. Dr. Dorothea Bartels			
Anbietende Lehreinheit(en)	FG Biologie, IMBIO			
Beteiligte Dozenten	Prof. Dr. Dorothea Bartels Dr. Horst Röhrig			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	1, 2, or 3

Lernziele	The students will learn protein purification methods, separation of protein mixtures by one and two-dimensional electrophoresis as well as expression, purification and enzymatic assays of recombinant proteins. The students will study protein phosphorylation patterns and will discuss the implications of dynamic changes in the phosphorylation status. The students will identify proteins by using immunocytochemistry. The students will become acquainted with protein identification approaches using mass spectrometry and data bank searches of protein sequences.
Schlüsselkompetenzen	Laboratory techniques in modern plant research. Skills for documentation and presentation of scientific experiments and data.
Inhalte	After the complete genome of Arabidopsis thaliana has been sequenced, the research interests are directed towards the functional analysis of the expressed genes. An important contribution towards the functional analysis is expected from protein analysis. This course will give an introduction into the different aspects of functional protein analysis. Proteins will be purified from different plant tissues and will be biochemically characterized. Proteins will be separated in one and two dimensional electrophoresis. Immunological protein detection assays will be performed as well as enzymatic reactions. Proteins will be expressed in E. coli, purified and their activities will be characterized in vitro.

PLPR	**Plant Proteomics**			
Teilnahme-voraussetzungen	Any PBPM module			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lab Course - Plant Proteomics (8)	8	300	10
Prüfung(en)		benotet/unbenotet		
	Oral and/or poster presentation Protocol to the excercises	Graded (50%) Graded (50%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course	benotet/unbenotet		
Sonstiges	Recommended Reading Taiz L, Zeiger E (2002) Plant Physiology. Sinauer Associates Inc., Sunderland, MA			

Plant Molecular Stress Physiology				universitätbonn
Modulnummer **PMSP**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **WS & SS**
Modulbeauftragter	Prof. Dr. Dorothea Bartels			
Anbietende Lehreinheit(en)	FG Biologie, IMBIO			
Beteiligte Dozenten	Prof. Dr. Dorothea Bartels / N.N.			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	1, 2, or 3
	M. Sc. OEP Biology	Wahlpflicht	1, 2, or 3

Lernziele	The students will learn that adaptations to environmental cues (in particular dehydration) will be possible by a specific gene expression programme. The students will learn to analyse expression patterns on the transcriptional and translational level including RNA blots, protein blots and promoter reporter gene studies. This modul offers an introduction to basic approaches in plant molecular biology including the generation of transgenic plants.
Schlüsselkompetenzen	Laboratory techniques in modern plant research. Skills for documentation and presentation of scientific experiments and data.
Inhalte	Plants respond to adverse environments with a specific gene expression programme. The stress responsive genes allow the plants to adapt and /or to tolerate the stress situation. Model plants showing extreme stress tolerance and A. thaliana will be used to analyse and to understand the changes which take place during abiotic environmental stress conditions. During the course the students will investigate stress responses on the transcriptional and translational level as well as analyse regulatory sequences involved in stress specific gene expression.

PMSP	**Plant Molecular Stress Physiology**			
Teilnahme-voraussetzungen	Any PBPM module			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lab Course - Plant Stress Physiology (12)	8	300	10
Prüfung(en)		benotet/unbenotet		
	Oral and/or poster presentation Protocol to the excercises	Graded (50%) Graded (50%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course	benotet/unbenotet		
Sonstiges	Recommended Reading Taiz L, Zeiger E (2002) Plant Physiology. Sinauer Associates Inc., Sunderland, MA			

Phytochemistry: Methods of Chemical Analytics in Plant Science				universitätbonn
Modulnummer **PHCH**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **WS**
Modulbeauftragter	Prof. Dr. Lukas Schreiber			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	Prof. Dr. Lukas Schreiber PD Dr. Rochus Franke			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	1,3

Lernziele	In this course students learn how to use modern techniques of analytical chemistry in modern plant sciences. This includes the quantitative analysis of secondary plant metabolites and the interpretation of mass spectra.
Schlüsselkompetenzen	Laboratory techniques in modern plant research. Skills for documentation and presentation of scientific experiments and data.
Inhalte	In this lab course methods of chemical analytics used in studying secondary plant metabolites are applied. Different techniques of chromatography (thin layer chromatography, gas chromatography and mass spectrometry) will used analysing the plant cell wall polymers lignin, suberin, cutin and associated waxes. Wildtype and transgenic Arabidopsis plants with altered lignin, suberin, cutin and associated waxes composition will be used as model organism for the experiments.

PHCH	**Phytochemistry: Methods of Chemical Analytics in Plant Sciences**			
Teilnahme-voraussetzungen	Any PBPM module			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lab Course - Phytochemistry: Methods of Chemical Analytics (10)	8	300	10
Prüfung(en)		benotet/unbenotet		
	Oral and/or poster presentation	Graded		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course Protocol to the excercises	benotet/unbenotet		
Sonstiges	Recommended Reading Bob B. Buchanan, Wilhelm Gruissem, and Russel L. Jones. Biochemistry and Molecular Biology of Plants, Rockville, MD:American Society of Plant Physiologists, 2000. Lincoln Taiz and Eduardo Zeiger. Plant Physiology, Sunderland, MA:Sinauer, 2006.			

Transgenic Plants				universitätbonn
Modulnummer **TRPL**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **WS**
Modulbeauftragter	Prof. Dr. Volker Knoop			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	Prof. Dr. Volker Knoop			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	3

Lernziele	By the end of the course students should have obtained a good understanding in theory and practice for molecular biological techniques, of plant genomes, gene structures, the biology of plant transformation via Agrobacterium, the use of indicator genes and strategies of gene inactivation and subsequent physiological analyses.
Schlüsselkompetenzen	Laboratory techniques in modern plant research. Skills for documentation and presentation of scientific experiments and data.
Inhalte	The lab course will deal with all experimental steps in construction and analyses of transgenic lines in the model plant Arabidopsis thaliana: Creation of DNA constructs for transformation, PCR, cloning in the GATEWAY system and sequence analyses, transformation of Escherichia coli, Agrobacterium tumefaciens and Arabidopsis, analysis of GFP- and GUS-reporter gene fusions and T-DNA and RNAi knockout plants. Students will get hands-on experience in these molecular lab techniques including enzymatic treatments, electrophoresis and blotting procedures as well as the physiological analysis of transgenic Arabidopsis lines.

TRPL	**Transgenic Plants**			
Teilnahme-voraussetzungen	Any PBPM module			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lab Course - Transgenic Plants: construction & analyses (12)	8	300	10
Prüfung(en)		benotet/unbenotet		
	Oral presentation Lab performance	Graded (60%) Graded (40%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course	benotet/unbenotet		
Sonstiges	Recommended Reading John Bowman. Arabidopsis: An atlas of morphology and development, Springer, 1994. Bob B. Buchanan, Wilhelm Gruissem, and Russel L. Jones. Biochemistry and Molecular Biology of Plants, Rockville, MD:American Society of Plant Physiologists, 2000. Frank Kempken and Renate Kempken. Gentechnik bei Pflanzen, Heidelberg:Springer, 2006. Slater, Scott, Fowler: „Plant Biotechnology, OUP (2003)			

Plant Molecular Cell Physiology and Biotechnology				universitätbonn
Modulnummer **MCPB**	Workload **300h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **SS**
Modulbeauftragter	Prof. Dr. Peter Dörmann			
Anbietende Lehreinheit(en)	FG Biologie, IMBIO			
Beteiligte Dozenten	Prof. Dr. Peter Dörmann			
Verwendbarkeit des Moduls	Studiengang		Modus	Studiensemester
	M. Sc. Plant Sciences		Wahlpflicht	2
Lernziele	The students will learn techniques of modern plant biochemistry, molecular biology and genetics..			
Schlüsselkompetenzen	Laboratory techniques in modern plant research. Skills for documentation and presentation of scientific experiments and data.			
Inhalte	The lab course includes modern techniques of biochemistry, molecular biology and genetics employing the model plant Arabidopsis thaliana. In this course, we will work on mutant lines of Arabidopsis deficient in specific steps of lipid or carbohydrate metabolism. The mutant lines which are derived from ongoing research projects will be biochemically characterized employing different analytical methods (thin-layer chromatography, HPLC, GC-MS, CE). Mutations derived from chemical mutagenesis will be mapped to the Arabidopsis genome using different PCR based markers (CAPS, SSLP).			

MCPB	**Plant Molecular Cell Physiology and Biotechnology**			
Teilnahme-voraussetzungen	Any PBPM module			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lab Course - Plant Molecular Cell Physiology and Biotechnology (10)	8	300	10
Prüfung(en)		benotet/unbenotet		
	Oral and/or poster presentation Protocol to the excercises	Graded (50%) Graded (50%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course	benotet/unbenotet		
Sonstiges	Recommended Reading Chapter 10 (Lipids) of the textbook: Biochemistry and Molecular Biology of Plants (eds. Buchanan, Gruissem, Jones; American Society of Plant Biologists)..			

Plant Cell Dynamics				universitätbonn
Modulnummer **PLCD**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **SS**
Modulbeauftragter	Prof. Dr. Diedrik Menzel			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	Prof. Dr. Diedrik Menzel d. Dr. Boris Voigt			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	2

Lernziele	Students will be given a solid introduction into plant cell biology with emphasis on plant cell compartimentation, dynamics, cell polarity and tissue specific cell differentiation in the context of plant growth and development. Principles and applications of GFP-technology will be thoroughly described along with current methods of transient and stable plant transformation techniques. Students will also be trained to apply modern microscopic imaging techniques. The course will demonstrate, how suitable experimental strategies can be developed for addressing specific questions of cellular dynamics by choosing, designing and applying the appropriate experimental tools.
Schlüsselkompetenzen	Laboratory techniques in modern cell biology, microscopy and visualization. Skills for documentation and presentation of scientific experiments and data.
Inhalte	Cell shape and tissue-specific cellular functions are highly depend on dynamic interactions between the cytoskeleton, the endomembrane system and the cell wall. Recent advances in confocal microscopy, digital image processing and recombinant fluorescent reporter protein design have created powerful tools to obtain live images of specific cell structures and molecular components in 3D data sets. With these tools the structure and fate of molecular cell components can be analysed over time in the context of cellular morphogenesis and differentiation in wild type and mutant plant lines and in cell culture. Likewise, the reaction of cells and tissues to external stimuli and challenges by stress and pathogen attack can be followed in great detail.

PLCD	**Plant Cell Dynamics**			
Teilnahme-voraussetzungen	Any PCDU module			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lab Course - Plant Cell Dynamics (10)	8	300	10
Prüfung(en)		benotet/unbenotet		
	Oral and/or poster presentation Protocol to the excercises	Graded (50%) Graded (50%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course	benotet/unbenotet		
Sonstiges	Recommended Reading Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. Molecular biology of the cell, New York:Garland Science, 2002. John Bowman. Arabidopsis: An atlas of morphology and development, Springer, 1994. Bob B. Buchanan, Wilhelm Gruissem, and Russel L. Jones. Biochemistry and Molecular Biology of Plants, Rockville, MD:American Society of Plant Physiologists, 2000. Barry W. Hicks. Green fluorescent protein: Applications and protocols, Humana Press, 2002. C. J. Staiger, F. Baluska, D. Volkmann, and P. Barlow. Actin: A dynamic framework of multiple plant cell functions, Kluwer, 2000.			

Plant Ultrastructure and Immunochemistry				universitätbonn
Modulnummer **PLUL**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **WS**
Modulbeauftragter	Prof. Dr. Diedrik Menzel			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	Prof. Dr. Diedrik Menzel			
Verwendbarkeit des Moduls	Studiengang		Modus	Studiensemester
	M. Sc. Plant Sciences		Wahlpflicht	1 or 3
Lernziele	Students will be given a solid basis of plant cell structure and an introduction into the methodology of ultrastructural research. They will be able to apply classic methods of tissue fixation, dehydration, embedment and ultrasectioning, and receive hands on experience on the application of pre- and post-embedding immunogold labelling of antigens in plant tissue sections.			
Schlüsselkompetenzen	Laboratory techniques in modern cell biology, microscopy and visualization. Skills for documentation and presentation of scientific experiments and data.			
Inhalte	The informations on the cell´s ultrastructure and localization of macromolecular components are indispensable for the reconstruction of subcellular architecture. High resolution transmission electron microscopy of fixed and embedded plant material in conjunction with immunogold histochemistry are modern tools to achieve this goal. This module will summarize the contributions of ultrastructural research to understanding plant cell structure and function. The application of immunogold histochemistry will be demonstrated in specific examples.			

PLUL	**Plant Ultrastructure and Immunochemistry**			
Teilnahme-voraussetzungen	Any PCDU module			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lab Course - Practice in Plant Ultrastructure (8)	8	300	10
Prüfung(en)		benotet/unbenotet		
	Oral and/or poster presentation Protocol to the excercises	Graded (50%) Graded (50%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course	benotet/unbenotet		
Sonstiges	Recommended Reading Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. Molecular biology of the cell, New York:Garland Science, 2002. William V. Dashek. Methods in plant electron microscopy and cytochemistry, Humana Press, 2000. A. W. Robards. Dynamic aspects of plant ultrastructure, McGraw Hill, 1974.			

Plant Development and Communication				universitätbonn
Modulnummer **PLDE**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **SS**
Modulbeauftragter	PD Dr. Frantisek Baluska			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	PD Dr. Frantisek Baluska			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	2

Lernziele	Students will acquire a solid background of plant development and morphogenesis, with special focus on root apex organogenesis and root development. They will learn the basic principles of microscopic imaging techniques, particularly using root sections allowing three-dimensional reconstruction of extended root tissues. Experimental strategies will be developed for addressing specific questions related to cell-to-cell communication, tissue morphogenesis, and root development.
Schlüsselkompetenzen	Laboratory techniques in modern cell biology, microscopy and visualization. Skills for documentation and presentation of scientific experiments and data.
Inhalte	Elongated plant cells assemble into lengthy cell files via their end-poles: adhesive domains enriched with pectins and traversed by abundant primary plasmodesmata. Complex interactions between the actin cytoskeleton and vesicle recycling characterize this synaptic communication along cell files. Individual cell files interact laterally at pectin/callose enriched pit-fields encompassing secondary plasmodesmata to form three-dimensional plant tissues. Recent data identified myosin VIII and plant synaptotagmins as the most critical molecules which organize these plant synapses transporting auxin from cell-to-cell. Auxin regulates morphogenesis and development of plant organs such as roots. On the example of root apices, the basic processes driving plant organogenesis including gravity-related processes will be analysed and general conclusion will be extracted and discussed.

PLDE	**Plant Development and Communication**			
Teilnahme-voraussetzungen	Any PCDU module			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lab Course - Plant Development (10)	8	300	10
Prüfung(en)		benotet/unbenotet		
	Oral and/or poster presentation Protocol to the excercises	Graded (50%) Graded (50%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course	benotet/unbenotet		
Sonstiges	Recommended Reading Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. Molecular biology of the cell, New York:Garland Science, 2002. John Bowman. Arabidopsis: An atlas of morphology and development, Springer, 1994. Bob B. Buchanan, Wilhelm Gruissem, and Russel L. Jones. Biochemistry and Molecular Biology of Plants, Rockville, MD:American Society of Plant Physiologists, 2000. Barry W. Hicks. Green fluorescent protein: Applications and protocols, Humana Press, 2002. C. J. Staiger, F. Baluska, D. Volkmann, and P. Barlow. Actin: A dynamic framework of multiple plant cell functions, Kluwer, 2000.			

Plant Physiology and Cell Biology				universitätbonn
Modulnummer **PPCB**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **WS**
Modulbeauftragter	Prof. Dr. Peter Dörmann			
Anbietende Lehreinheit(en)	FG Biologie, IMBIO			
Beteiligte Dozenten	Prof. Dr. Peter Dörmann			
Verwendbarkeit des Moduls	Studiengang		Modus	Studiensemester
	M. Sc. Plant Sciences		Wahlpflicht	1 or 3
Lernziele	Students will acquire basic knowledge on different plant culture systems, and the use of these techniques in plant biotechnology.			
Schlüsselkompetenzen	Laboratory techniques in modern cell biology, microscopy and visualization. Skills for documentation and presentation of scientific experiments and data.			
Inhalte	The practical lab course on plant physiology and cell biology will focus on basic techniques of molecular biology, plant cell culture, plant expression systems and plant physiology. Modern plant biology includes different plant culture techniques including growth of whole plants on soil, plant callus cultures, suspension cell cultures and protoplast preparation. Depending on the plant species and culture system, a range of transformation protocolls are available, and the most relevant techniques will be presented during this lab course. Preparation of protoplasts from leaves, protoplast fusion, induction of callus growth from leaf discs, suspension cell cultures, biolistic transformation of plants (leaf discs) with reporter constructs, Agrobacterium-mediated transformation, cloning in Escherichia coli and Agrobacterium tumefaciens, screening of transgenic lines, detection of transgenes by PCR			

PPCB	**Plant Physiology and Cell Biology**			
Teilnahme-voraussetzungen	Any PCDU module			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lab Course - Plant Molecular Cell Physiology and Biotechnology 1 (12)	8	300	10
Prüfung(en)		benotet/unbenotet		
	Oral and/or poster presentation Protocol to the excercises	Graded (50%) Graded (50%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course	benotet/unbenotet		
Sonstiges	Recommended Reading Chapter 10 (Lipids) of the textbook: Biochemistry and Molecular Biology of Plants (eds. Buchanan, Gruissem, Jones; American Society of Plant Biologists)			

Plant Evolution and Phylogeny Lab				universitätbonn
Modulnummer **PEPL**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **SS**
Modulbeauftragter	Prof. Dr. Volker Knoop			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	Prof. Dr. Volker Knoop			
Verwendbarkeit des Moduls	Studiengang		Modus	Studiensemester
	M. Sc. Plant Sciences		Wahlpflicht	2
	M. Sc. OEP Biology		Wahlpflicht	2
Lernziele	By the end of the course students should have obtained a good understanding of land plant evolution from a molecular genomic point of view. They should be able to answer question on molecular biological techniques as well as on the diversity of land plant clades and the different approaches taken in molecular phylogenetic analyses.			
Schlüsselkompetenzen	Laboratory techniques in molecular biology. Problem oriented planning of experimental strategies. Project-oriented cooperation in small research groups. Skills for documentation and presentation of scientific experiments and data.			
Inhalte	The lab course will deal with the phylogenetic information stored over 500 million years of land plant evolution, stored in the genomes of living plants. Molecular techniques, mainly DNA and RNA extraction, cDNA synthesis, PCR amplification, cloning and sequencing and computer programs for database analyses and molecular phylogenetic constructions will be used to retrieve this information. Taxonwise, a focus will be the extant representatives of lower land plants, the bryophytes, lycophytes and monilophytes and locuswise a focus will be the mitochondrial DNA of plants with its peculiar mechanisms of gene expression such as RNA editing and trans-splicing.			

PEPL	**Plant Evolution and Phylogeny Lab**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lab Course - Plant Molecular Phylogenetics (12)	8	300	10
Prüfung(en)		benotet/unbenotet		
	Written examination Oral presentation (30 min)	Graded (40%) Graded (60%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course	benotet/unbenotet		
Sonstiges	Recommended Reading Dan Graur and Wen-Hsiung Li. Fundamentals of Molecular Evolution, Sunderland, MA:Sinauer Associates, Inc., 2000 Volker Knoop and Kai Müller. Gene und Stammbäume, Heidelberg, München:Elsevier Spektrum, 2006. R. D. M. Page and E. C. Holmes. Molecular evolution. A phylogenetic approach., Oxford:Blackwell Science Ltd., 1998. J.-W. Wägele. Grundlagen der phylogenetischen Systematik, München:Verlag Dr. Friedrich Pfeil, 2001. “Phylogenetic trees made easy”, Hall BG, Sinauer Assoc., Sunderland, MA (2001) „The mitochondrial DNA of land plants: peculiarities in phylogenetic perspective“, Knoop V, Curr. Genet. 46:123-139 (2004)			

Plant Molecular Evolution and Phylogeny				universitätbonn
Modulnummer **PMEP**	Workload **150 h**	Umfang **5 CP**	Dauer Modul **1 Semester**	Turnus **SS**
Modulbeauftragter	Prof. Dr. Volker Knoop			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	Prof. Dr. Volker Knoop			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	2
	M. Sc. OEP Biology	Wahlpflicht	2

Lernziele	Understanding the fundamentals of modern molecular phylogenetics.
Schlüsselkompetenzen	Evolutionary-based understanding of modern phylogenetics, taxonomy and cladistics, use of databases and database query searching, understanding concepts and algorith of phylogenetic software tools for data assembly, alignments and construction of phylogenetic trees.
Inhalte	Molecular data offer a plethora of information to reconstruct the phylogeny of life on earth. After a brief introduction into the basics of molecular biology (genomes, gene structures, exons, introns, genetic codes, nucleotide and protein sequences) as well as cladistics and systematics the lecture will mainly deal with the methods of phylogenetic analyses: Homologies, data base seraches, alignments and the concepts ofphylogenetic tree construction (distance, parsimony and likelihoodmethods). Students will be strongly encouraged to gain hand-son experience using WWW accessible resources and freely available software such as MEGA et c.

PMEP	**Plant Molecular Evolution and Phylogeny**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lecture - Molecular Evolution and Phylogenetics (40) Seminar - Plant Phylogeny and Evolution (15)	2 1	120 30	4 1
Prüfung(en)		benotet/unbenotet		
	Written examination Oral presentation (30 min), protocol to the excercises	Graded (50%) Graded (50%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lecture and seminar	benotet/unbenotet		
Sonstiges	Recommended Reading Dan Graur and Wen-Hsiung Li. Fundamentals of Molecular Evolution, Sunderland, MA:Sinauer Associates, Inc., 2000 Volker Knoop and Kai Müller. Gene und Stammbäume, Heidelberg, München:Elsevier Spektrum, 2006. R. D. M. Page and E. C. Holmes. Molecular evolution. A phylogenetic approach., Oxford:Blackwell Science Ltd., 1998. J.-W. Wägele. Grundlagen der phylogenetischen Systematik, München:Verlag Dr. Friedrich Pfeil, 2001. “Phylogenetic trees made easy”, Hall BG, Sinauer Assoc., Sunderland, MA (2001) „The mitochondrial DNA of land plants: peculiarities in phylogenetic perspective“, Knoop V, Curr. Genet. 46:123-139 (2004)			

Plant Molecular Systematics				universitätbonn
Modulnummer **PMSY**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **WS**
Modulbeauftragter	Prof. Dr. Dietmar Quandt			
Anbietende Lehreinheit(en)	FG Biologie, Nees Institut			
Beteiligte Dozenten	Prof. Dr. Dietmar Quandt			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	3
	M. Sc. OEP Biology	Wahlpflicht	3

Lernziele	Participants should gain a fundamental understanding of molecular evolutionary processes governing the change of DNA, and the application of this information to phylogenetic and evolutionary analysis. Aims include to develop skills in (1) generating molecular data from plants in the lab, (2) using computers for phylogeny reconstruction (3) estimating parameters such as substitution rates and divergence times, and (4) evaluating specific processes important in plant evolution such as hybridization, polyploidy and reticulate evolution.
Schlüsselkompetenzen	Laboratory skills, molecular techniques, statistical methods, skills for the generation, analysis, and presentation of scientific data.
Inhalte	Our understanding of plant relationships and evolution has been revolutionized in the past decade using information from DNA sequences. Major emphasis in the modul is put on providing an introduction to the rapidly developing methods in the field, both in the laboratory and at the computer. Sources of information treated range from the nucleotide sequence to the genome level. Case studies deal with important groups such as angiosperms, ferns and bryophytes in greater detail.

PMSY	**Plant Molecular Systematics**			
Teilnahme-voraussetzungen	PSBE2			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lab Course - Plant Molecular Systematics (8)	8	300	10
Prüfung(en)		benotet/unbenotet		
	Oral and/or poster presentation Protocol to the excercises	Graded (50%) Graded (50%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course	benotet/unbenotet		
Sonstiges	Recommended Reading D. Hillis, C. Moritz and B. Mable (1996): Molecular Systematics (2nd ed.). Sinauer. D. Soltis, P. Soltis and J Doyle (1998): Molecular Systematics of Plants II (DNA Sequencing). Kluwer. Volker Knoop and Kai Müller. Gene und Stammbäume, Heidelberg, München:Elsevier Spektrum, 2006. K. Weising et al. DNA fingerprinting in plants and fungi (stark aktualisierte Neuauflage in 2005) R. Page & E. Holmes (1998): Molecular Evolution - A Phylogenetic Approach. Blackwell.			

Plant Biogeography and Conservation				universitätbonn
Modulnummer **PBCO**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **WS**
Modulbeauftragter	Prof. Dr. Wilhelm Barthlott			
Anbietende Lehreinheit(en)	FG Biologie, Nees Institut			
Beteiligte Dozenten	Barthlott d. Mitarb. Dr. Jens Mutke			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	3
	M. Sc. OEP Biology	Wahlpflicht	3

Lernziele	By the end of the module, students should be able to design and perform analyses in the fields of macroecology and biogeography using GIS, spatial data analyses, and statistics.
Schlüsselkompetenzen	GIS and geostatistical methods, skills for planning, performing, documentation, and presentation of scientific analyses.
Inhalte	Understanding the spatial distribution of biodiversity is crucial for its further exploration, use, and conservation. This module combines an introduction in spatial data analysis using GIS with theory and excercises from the fields of macroecology and biogeography. A special focus will be conservation biology including priority setting and analyses of the impact of global environmental change on biodiversity.

PBCO	**Plant Biogeography and Conservation**			
Teilnahme-voraussetzungen	Any PSBE			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Seminar - Biogeography and Conservation (10) Lab Course - Biogeography and Conservation (10)	1 7	60 240	2 8
Prüfung(en)		benotet/unbenotet		
	Oral and/or poster presentation Protocol to the excercises	Graded (50%) Graded (50%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course	benotet/unbenotet		
Sonstiges	Recommended Reading BLACKBURN & GASTON 2003: Macroecology: Concepts and Consequences. Cambridge Univ Press BROWN, J.H., RIDDLE, B.R. & LOMOLINO, M.V. 2005: Biogeography. 3rd Ed.. Sinauer. 752 pp PRIMACK: Essentials of Conservation Biology.Sinauer. SCHULZE, BECK & MÜLLER-HOHENSTEIN 2005: Plant Ecology. Springer. 702 pp			

Plant Biodiversity - Systematics and Biology of Flowering Plants?				universitätbonn
Modulnummer **PBIO**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **SS**
Modulbeauftragter	Prof. Dr. Wilhelm Barthlott			
Anbietende Lehreinheit(en)	FG Biologie, Nees Institut			
Beteiligte Dozenten	Prof. Dr. Wilhelm Barthlott d. Mitarb. N.N.			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	2
	M. Sc. OEP Biology	Wahlpflicht	2

Lernziele	At the end of the module students should have a sound overview about the major lineages and families of vascular plants, their systematics, morphology, and basic ecology. They will be familiar with the most important methods and terminology in the field of morphology, taxonomy, and systematics.
Schlüsselkompetenzen	Methods for the documentation and analysis of plant morphology and floral biology, taxonomic methods, Skills for visual and oral presentation of scientific data.
Inhalte	The course gives an overview on the systematics, morphology, and biology (e.g., floral biology) of (vascular) plants based mainly on living material from the botanic garden, as well as on herbarium material. Methods for the documentation and analysis of plant diversity from the field of morphology, taxonomy, and, e.g., floral biology are taught.

PBIO	**Plant Biodiversity - Systematics and Biology of Flowering Plants**			
Teilnahme-voraussetzungen	Any PSBE module			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lab Course - Systematics and Biology of Seed Plants (12)	8	300	10
Prüfung(en)		benotet/unbenotet		
	Oral and/or poster presentation Protocol to the excercises	Graded (50%) Graded (50%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course	benotet/unbenotet		
Sonstiges	Recommended Reading JUDD, W.S., CAMPBELL, C.S., KELLOG, E.A. & STEVENS, P.F. (2002): Plant Systematics. A phylogenetic approach. Sinauer Associates, Inc., Massachusetts (USA). KUBITZKI, K. (ed.) (1993 -): The families and genera of vascular plants. Several Volumes. - Springer; Heidelberg. SITTE, P., WEILER, E.W., KADEREIT, J.W., BRESINSKY, A., KÖRNER, C.: Strasburger Lehrbuch der Botanik. - G. Fischer; Stuttgart.			

Palaeobotany and Palynology				universitätbonn
Modulnummer **PAPA**	Workload **300 h**	Umfang **10CP**	Dauer Modul **1 Semester**	Turnus **SS**
Modulbeauftragter	Prof. Dr. Thomas Litt			
Anbietende Lehreinheit(en)	FG Geowissenschaften, IfP			
Beteiligte Dozenten	Prof. Dr. Thomas Litt			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	2
	M. Sc. OEP Biology	Wahlpflicht	2

Lernziele	Participants should gain an understanding of the evolution of land plants based on macro- and micropalaeobotanical data, and the application of this information to phylogenetic and evolutionary analysis. Aims include to develop skills in (1) morphological analysis of fossil plants, (2) introduction into the pollen morphology and pollen analysis (3) using SEM and Confocal Laser-Scanning Microscop (4) evaluation of palaeobotanical data in comparison with current research on ancient DNA and other biomolecular markers.
Schlüsselkompetenzen	Obtaining a profound understanding of the plant fossil record and its evolutionary significance.
Inhalte	Palaeobotany and palynology play a fundamental role to understand the evolution of plants from the earliest forms to the the development of our present flora. Based on fossil material the plant evolution will be placed in the context of time, climate change and mass extinction. The course focusses on periods when major evolutionary changes occurred and addresses the rates and timing of the evolutionary change seen in the plant fossil records.

PAPA	**Palaeobotany and Palynology**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lecture - Palaeobotany and terrestrial palaeoecology (50) Lab Course - Palaeobotany and Palynology (15)	2 6	60 240	2 8
Prüfung(en)		benotet/unbenotet		
	Final written examination Protocol to the lab course	Graded (50%) Graded (50%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course	benotet/unbenotet		
Sonstiges	Recommended Reading Moore, Webb, Collinson: Pollen Analysis Steward, Rothwell: Paleobotany and the Evolution of Plants Taylor, Taylor: The Biology and Evolution of Fossil Plants Willis, McElwain: The Evolution of Plants			

Physiology of Nutrient Uptake and Translocation				universitätbonn
Modulnummer **PNUT (MA-P-08)**	Workload **180 h**	Umfang **6 CP**	Dauer Modul **1 Semester**	Turnus **SS**
Modulbeauftragter	Prof. Dr. Heiner Goldbach			
Anbietende Lehreinheit(en)	Landwirtschaftliche Fakultät, INRES - Plant Nutrition-			
Beteiligte Dozenten	Prof. Dr. Heiner Goldbach			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	2
	M. Sc. Agrarwissenschaften	Wahlpflicht	2

Lernziele	To gain: i) a fundamental understanding of physiological processes governing nutrient uptake and nutrient functions in plants. ii) in-depth knowledge about adaptive mechanisms to compensate for low or excessive levels of nutrients and toxic elements; Participants should be able to set up standard experiments in plant nutrition to assess uptake and translocation of nutrients, awareness of experimental biases;
Schlüsselkompetenzen	Experimental design and data evaluation, presentation skills (oral and written), evaluation of scientific literature
Inhalte	Pathways of nutrient uptake and translocation within the plant (root and foliar uptake); transport mechanisms at the membrane level: ATPases and reductases as driving forces for solute uptake; carriers, channels, co-transporters, endocytosis as mechanisms for solute uptake; tissue- and condition - specific expression of transporters; influence of environmental factors on solute uptake; incorporation of nutrients into plant metabolism (N, S, P); processes of biological N2 reduction and influencing factors; control of plant growth and development by nutrient supply; uptake and functions of trace elements; experimental approaches in physiological plant nutrition: experimental designs: pro's and con's, possible biases.

PNUT (MA-P-08)	**Physiology of nutrient uptake and translocation**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lecture - Physiology of nutrient uptake and translocation (24) Seminar - Physiology of nutrient uptake and translocation (24)	2 2	90 90	3 3
Prüfung(en)		benotet/unbenotet		
	Written test of the contents of the lecture oral and poster presentation of the experiments in the context of a project seminar	Graded (50%) Graded (50%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in course	benotet/unbenotet		
Sonstiges	Recommended Reading Martin R. Broadley and Philip J. White. Plant nutritional genomics, CRC Press, 2005. Marschner, H. (1995/2006) Mineral Nutrition of Higher Plants. 2nd/3rd Edition, Academic Press, NewYork, London, ISBN 0-12-473542-8 (hardcover) / 0-12-473543-6 (paperback) Mengel, K., Kirkby, E. (2001): Principles of Plant Nutrition; Kluwer Acad. Publishers, 5th Edition N. K. Fageria, V. C. Baligar, and R. B. Clark. Physiology of crop production, Haworth, 2006. Rengel, Z. (1998) Nutrient Use in Crop Production. Harworth Press, Binghamton) Rengel, Z. (1999) Mineral Nutrition of Crops, The Haworth Press, Inc., 141-168.			

Interactions between Crop Nutrition and the Environment				universitätbonn
Modulnummer **ICNE (MA-P-06)**	Workload **180 h**	Umfang **6 CP**	Dauer Modul **1 Semester**	Turnus **WS**
Modulbeauftragter	Prof. Dr. Heiner Goldbach			
Anbietende Lehreinheit(en)	Landwirtschaftliche Fakultät, INRES - Plant Nutrition-			
Beteiligte Dozenten	Prof. Dr. Heiner Goldbach			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	1 or 3
	M. Sc. Agrarwissenschaften	Wahlpflicht	1 or 3

Lernziele	To gain a fundamental understanding of i) processes relevant for nutrient uptake from soils and substrate, ii) processes and conditions prevailing in the rhizosphere, iii) processes on and conditions in the phyllosphere as related to uptake and leaching of nutrients; iv) to develop expertise to identify the nutrient status and assess the nutrient demand of crops. Participants should learn how to influence nutrient uptake and balance nutrition by organic and mineral fertilizer application and be aware of the pro's and con's of the most common approaches of nutrient testing in soils and crops.
Schlüsselkompetenzen	Experimental design and data evaluation, presentation skills (oral and written), evaluation of scientific literature
Inhalte	Diagnosis and consequences of nutritional imbalances, including common symptoms; assessing and modelling of nutrient uptake; environmental factors controlling nutrient availability and uptake; assessment of nutrient efficiency under field conditions: methods and biases; organismic and abiotic interactions, conditions and processes in rhizosphere and phyllosphere as related to solute uptake; management of nutrient supply (organic and inorganic fertilizers); relevant methods for assessing the nutrient status of soils and crops (standard soil extraction procedures, tissue analysis, DRIS evaluation; field and lab experiments).

ICNE (MA-P-06)	**Interactions between crop nutrition and the environment**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lecture - Interactions between crop nutrition and the environment (24) Seminar - Interactions between crop nutrition and the environment (24)	2 2	90 90	3 3
Prüfung(en)		benotet/unbenotet		
	Written test of the contents of the lecture Oral and/or poster presentation of the experiments in the context of a seminar	Graded (50%) Graded (50%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in course	benotet/unbenotet		
Sonstiges	Recommended Reading Epstein, E., Bloom, A.J. (2004) Mineral Nutrition of Plants: Principles and Perspectives. Sinauer Associates; 2nd edition 400 pp ISBN: 0878931724 Marschner, H. (1995/2006) Mineral Nutrition of Higher Plants. 2nd/3rd Edition, Academic Press, NewYork, London, ISBN 0-12-473542-8 (hardcover) / 0-12-473543-6 (paperback) Rengel, Z. (1998) Nutrient Use in Crop Production. Harworth Press, Binghamton) Rengel, Z. (1999) Mineral Nutrition of Crops, The Haworth Press, Inc.,			

Genome Analysis in Plant Breeding				universitätbonn
Modulnummer **GAPB**	Workload **180 h**	Umfang **6 CP**	Dauer Modul **1 Semester**	Turnus **SS**
Modulbeauftragter	Prof. Dr. J. Léon			
Anbietende Lehreinheit(en)	INRES, Spezieller Pflanzenbau und Pflanzenzüchtung			
Beteiligte Dozenten	Prof. Dr. J. Léon			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	2
	M. Sc. Agrarwissenschaften	Wahlpflicht	

Lernziele	The students will be introduced to theoretical and practical aspects of the analysis of plant genomes which are relevant to plant breeding.
Schlüsselkompetenzen	General and quantitative genetics, molecular biology of crop plants, molecular plant breeding
Inhalte	The genome analysis in plant breeding is focused on the molecular analysis of inheritable traits in crop plants. The field is located at the junction between classi-cal plant breeding and the relatively recent field of molecular biology. The aims are to improve varieties by means of molecular marker techniques. DNA markers are short DNA sequences, which are inheritable and can be characterized in the laboratory. DNA markers are inherited like Mendelian factors and enable the breeders to understand the genetic architecture of each individual in a segregat-ing population. Applications of DNA markers in plant breeding are numerous. During the course of the lecture, (1) the generation of linkage maps, (2) the detec-tion and selection of favorable genes for monogenic and polygenic, i.e. quantita-tive, traits, (3) the marker-assisted selection of favorable genotypes, (4) the identi-fication and differentiation of varieties and (5) the isolation and utilization of new genes in plant breeding, e.g for pathogen resistance, will be presented.

GAPB	**Genome Analysis in Plant Breeding**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lecture - Genome Analysis in Plant Breeding (30) Lab Course - Genome Analysis in Plant Breeding (12)	2 2	120 60	4 2
Prüfung(en)		benotet/unbenotet		
	Written exam	Graded		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Successful participation in the practical course	benotet/unbenotet Not graded		
Sonstiges	Recommended Reading Lörz, H. and G. Wenzel, 2005: Molecular Marker Systems in Plant Breeding and Crop Improvement. Springer (ISBN 3540206892) Meksem, K, and G. Kahl, 2005: The Handbook of Plant Genome Mapping. Wiley VCH (ISBN 3527311165)			

Plant and Environment: Molecular Ecology				universitätbonn
Modulnummer **PEME**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **SS**
Modulbeauftragter	Prof. Dr. Lukas Schreiber			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	Prof. Dr. Lukas Schreiber			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	2
	M. Sc. OEP Biology	Wahlpflicht	2

Lernziele	In this course students learn to use a variety of different techniques used to analyse plant environment interactions on a molecular level. This includes methods of analytical chemistry (gas chromatography and mass spectrometry), molecular biology (gene expression and reporter gene fusion) and transport physiology (water and herbicides transport across leaf surfaces).
Schlüsselkompetenzen	Laboratory techniques in modern plant research. Skills for documentation and presentation of scientific experiments and data.
Inhalte	In the lab course relevant examples of plant environment interactions on the molecular level will be studied. Arabidopsis thaliana will mostly be used as a model organism. Experiments will deal with water and salt stress, effects of xenobiotics on plants, plant micro organism interaction and secondary plant metabolites. Experimental approaches include measurement of chlorophyll fluorescence, porometry, measurement of cuticular transpiration and uptake of xenobiotics in leaves, chemical analytics and analysis of gene expression in response to environmental stimuli.

PEME	**Plant and Environment: Molecular Ecology**			
Teilnahme-voraussetzungen	Any PBPM module			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lab Course - Plant and Environment: Molecular Ecology (12)	8	300	10
Prüfung(en)		benotet/unbenotet		
	Oral presentation of experimental results obtained at the end of the lab course.	Graded		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course	benotet/unbenotet		
Sonstiges	Recommended Reading Taiz L, Zeiger E (2002) Plant Physiology. Sinauer Associates Inc., Sunderland, MA			

Plant Biodiversity and Conservation				universitätbonn
Modulnummer **PBDT**	Workload **210 h**	Umfang **7 CP**	Dauer Modul **1 Semester**	Turnus **WS**
Modulbeauftragter	Prof. Dr. Wilhelm Barthlott			
Anbietende Lehreinheit(en)	FG Biologie, Nees Institut			
Beteiligte Dozenten	Prof. Dr. Wilhelm Barthlott Dr. Wolfram Lobin Dr. Jens Mutke			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	1 or 3
	M. Sc. OEP Biology	Wahlpflicht	1 or 3

Lernziele	By the end of the modul, the students should be able to map the distribution and describe the nature of earth's major terrestrial biomes. They should have a sound understanding of the influence of the abiotic environment on plant communities and structure of the vegetation and have a first overview about conservation biology.
Schlüsselkompetenzen	Sound overview on vegetation ecology, overview on approaches, programs, and actors in biodiversity conservation.
Inhalte	The course deals with the field of vegetation ecology and conservation biology. This includes an introduction to the vegetation ecology of the world's major biomes and aspects of biodiversity conservation. The seminar is offered at two levels: 1) "Biodiversity and Conservation 1" for students who have not participated in that seminar in PSBE3. 2) "Biodiversity and Conservation 2" adds other aspects and details for students who already heard "Biodiversity and Conservation 1" in PSBE3.

PBDT	**Plant Biodiversity and Conservation**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lecture - Vegetation Geography (120) Seminar - Biodiversity and Conservation (15)	2 1	120 90	4 3
Prüfung(en)		benotet/unbenotet		
	Written test Oral presentation (30 min)	Graded (50%) Graded (50%)		
Studienleistungen	Regular participation in course	benotet/unbenotet		
u.a. als Zulassungs-voraussetzung zur Modulprüfung				
Sonstiges	Recommended Reading BROWN, J.H., RIDDLE, B.R. & LOMOLINO, M.V. 2005: Biogeography. 3rd Ed.. Sinauer. 752 pp FREY, W. & LÖSCH, R. (2004): Lehrbuch der Geobotanik. Elsevier, Spektrum Verlag. SCHULZE, BECK & MÜLLER-HOHENSTEIN 2005: Plant Ecology. Springer. 702 pp WALTER, H. & BRECKLE, S.-W. (1999): Vegetationszonen und Klima. 7. Aufl. UTB, Ulmer, Stuttgart			

Vegetation Ecology				universitätbonn
Modulnummer **PBEC**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **SS**
Modulbeauftragter	Prof. Dr. Wilhelm Barthlott			
Anbietende Lehreinheit(en)	FG Biologie, Nees Institut			
Beteiligte Dozenten	Prof. Dr. Wilhelm Barthlott Dr. Wolfram Lobin Dr. Jens Mutke Prof. Dr. Dietmar Quandt			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	2
	M. Sc. OEP Biology	Wahlpflicht	2

Lernziele	The students will learn methods of inventorying, identifying, and studying plants and vegetation types in relation to ecological factors. They should gain insight in the field work as well as related work in the herbarium and data analyses.
Schlüsselkompetenzen	Methods of field biology.
Inhalte	The course deals with the field of vegetation ecology and field biology . This includes field work and related work in the lab, the herbarium, and computer software to study the structure and floristic composition of plant communities. The field work includes one large (up to 2 weeks) or several small field trips.

PBEC	**Vegetation Ecology**			
Teilnahme-voraussetzungen	Any PBSE			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lab Course - Vegetation Ecology (incl. Fieldw. & Excurs.) (15)	8	300	10
Prüfung(en)		benotet/unbenotet		
	Oral and/or poster presentation Documentation/protocol	Graded (50%) Graded (50%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course	benotet/unbenotet		
Sonstiges	Recommend Reading BROWN, J.H., RIDDLE, B.R. & LOMOLINO, M.V. 2005: Biogeography. 3rd Ed.. Sinauer. 752 pp FREY, W. & LÖSCH, R. (2004): Lehrbuch der Geobotanik. Elsevier, Spektrum Verlag. SCHULZE, BECK & MÜLLER-HOHENSTEIN 2005: Plant Ecology. Springer. 702 pp WALTER, H. & BRECKLE, S.-W. (1999): Vegetationszonen und Klima. 7. Aufl. UTB, Ulmer, Stuttgart			

Plant Surfaces: structure and function				universitätbonn
Modulnummer **PSSF**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **WS**
Modulbeauftragter	Prof. Dr. Wilhelm Barthlott			
Anbietende Lehreinheit(en)	FG Biologie, Nees Institut			
Beteiligte Dozenten	Barthlott d. Mitarb.			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	3
	M. Sc. OEP Biology	Wahlpflicht	3

Lernziele	The goal is to give the students a broad overview over the functional micro- and nanostructures of plants. Methods for analysing of micro- and nanostructured biological surfaces become taught. Examples of surfaces and their specific properties will be presented. Basics and function of special microscopy techniques, like scanning electron microscopy and atomic force microscopy; as well the preparation of specimens should be learned. Within the exercises computer based image processing and analysis will be applied.
Schlüsselkompetenzen	Microscopy techniques, including scanning electron microscopy and atomic force microscopy.
Inhalte	The exercises give an overview about the diversity of micro- and nano structured plant surfaces, their application in plant systematic and their functional importance in plant interaction with the environment. X-ray micro analysis and computer based image processing will be applied. The seminar gives an introduction into the diversity of plant surface micro morphology; micro- and nanostructures; scanning electron and atomic force microscopy; plant waxes: chemistry, crystallinity, form and function; Self assembly of nanostructures; plant microstructures as biomimetic materials; non-biotic and biotic surface interactions.

PSSF	**Plant Surfaces: structure and function**			
Teilnahme-voraussetzungen	Any PSBE module			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Seminar - Plant Surfaces: structure and Function (15) Lab Course - Plant Surfaces: structure and Function (6)	1 7	60 240	2 8
Prüfung(en)		benotet/unbenotet		
	Oral and/or poster presentation Protocol to the experiments	Graded (50%) Graded (50%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course	benotet/unbenotet		
Sonstiges	Recommended Reading Hoppert, M. (2003): Microscopy techniques in Biotechnology. Wiley-VCH Kerstins G. (1996): Plant cuticles an integrated functional approach. ßIOS Scientific Publishers. Morris, V.J, Kirby, A.R. & Gunning, A.PA. (eds.) (1999): Atomic force microscopy for biologists. Imperial college press. London. Schmidt, P.F. (1994): Praxis der Rasterelektronenmikroskopie und Mikrobereichsanalyse. Expert Verlag			

Molecular Plant Microbe Interactions				universitätbonn
Modulnummer **MPMI**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **SS**
Modulbeauftragter	Dr. Bekir Ülker			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	Dr. Bekir Ülker			
Verwendbarkeit des Moduls	Studiengang		Modus	Studiensemester
	M. Sc. Plant Sciences		Wahlpflicht	2
Lernziele	The course aims at giving the participants a general overview and understanding of plant-microbe interactions. Empasis will be given to those plant pathogens causing tumors.			
Schlüsselkompetenzen	Laboratory techniques in molecular microbe and plant research. Searching, reading and understanding of scientific literature and databases. Skills for experimental design, documentation and presentation of scientific experiments and data.			
Inhalte	Besides a general overview and understanding of plant-microbe interactions, during this course, students will explore Agrobacterium's ability to cause disease (crawn gall) and genetically engineer plants. The molecular interactions between Agrobacterium and plant cells will be investigated and compared to other bacterial pathogens such as Pseudomonas syringae causing bacterial wilt disease in broad ranges of plants. Students will be introduced to other pathogens causing tumorous growths in plants and molecular understanding of tumor formation. Students will also learn about the current technologies used in crown gall disease control and attempts to develop pathogen resistant plants. The course will integrate lectures, student seminars, group discussions, method presentations, laboratory work and data analysis.			

MPMI	**Molecular Plant Microbe Interactions**			
Teilnahme-voraussetzungen	Any PBPM module			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lab Course – Molecular Plant Microbe Interaction (10)	8	300	10
Prüfung(en)		benotet/unbenotet		
	Oral and/or poster presentation Protocol to the excercises	Graded (50%) Graded (50%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course	benotet/unbenotet		
Sonstiges	Recommended Reading Agrobacterium: From Biology to Biotechnology. Tzfira, Tzvi; Citovsky, Vitaly (Eds.) 2008, ISBN: 978-0-387-72289-4 Agrobacterium Tumefaciens: From Plant Pathology To Biotechnology von Eugene Nester 2005, Milton P. Gordon, und Allen Kerr von Amer Phytopathological Society. ISBN-10: 0890543224.			

Plant Molecular Engineering				universitätbonn
Modulnummer **PMEG**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **SS & WS**
Modulbeauftragter	Dr. Bekir Ülker			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	Dr. Bekir Ülker			
Verwendbarkeit des Moduls	Studiengang		Modus	Studiensemester
	M. Sc. Plant Sciences		Wahlpflicht	1., 2., or 3.
Lernziele	Skills for independent working, designing and execution of experiments. Comprehensive literature and data searching skills. Documentation and writing of scientific data generated.			
Schlüsselkompetenzen	General molecular biology techniques. Advanced gene expression, vector designing, cloning as well as bacterial and plant transformation skills.			
Inhalte	Participants in this 6-weeks long lab course will be offered to select a topic of interest among several projects that our group is interested in researching. Students will be introduced to the challenges we are facing in feeding the ever increasing world population. Besides studying and learning the past and current efforts, they would be encouraged to conceive their own ways in developing solutions to this major problem. The participants will be introduced into how scientists are able to modify plant yield, tolerance to harsh environmental conditions, resistance to pathogens and insects, nutrition and pharmaceutical use to better suit the needs of producers and consumers using plant genetic engineering and biotechnology. They will learn that not every effort has been successful in engineering plants and that there are still major challenges ahead. In our research group we attempt to improve the current tools and methods to better enable scientists genetically engineer plants. Knowing the current problems in public acceptance of transgenic crops, improvements of biosafety of the tools and methods and hence the biosafety of transgenic crops is one of our most important goal.			

PMEG	**Plant Molecular Engineering**			
Teilnahme-voraussetzungen	Any PBPM module			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Lab Course - Plant Molecular Engineering (2)	8	300	10
Prüfung(en)		benotet/unbenotet		
	Oral and/or poster presentation Protocol to the excercises	Graded (50%) Graded (50%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course	benotet/unbenotet		
Sonstiges	Recommended Reading Bob B. Buchanan, Wilhelm Gruissem, and Russel L. Jones. Biochemistry and Molecular Biology of Plants, Rockville, MD:American Society of Plant Physiologists, 2000.			

Phototrophic Prokaryotes				universitätbonn
Modulnummer **PHPR**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus **WS and SS**
Modulbeauftragter	Prof. Dr. Christiane Dahl			
Anbietende Lehreinheit(en)	FG Biologie, Institut für Mikrobiologie und Biotechnologie			
Beteiligte Dozenten	Prof. Dr. Christiane Dahl			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	1, 2, or 3

Lernziele	By the end of the course students should know that phototrophy is not only main trait of plants but of many bacteria that play major roles as primary producers not only in anoxic but also in oxic environments. The students should gain a good understanding of the high versatility of phototrophic organisms and develop a concept of how the complex oxygen evolving photosystem may have developed from anoxygenic origins.
Schlüsselkompetenzen	Laboratory techniques in modern plant research. Skills for documentation and presentation of scientific experiments and data.
Inhalte	The module will cover oxygenic and anoxygenic phototrophic prokaryotes. Oxygenic prokaryotes (cyanobacteria and prochlorophytes) will be presented as prototypes for oxygenic photosynthesis performed by chloroplasts in plants. The different groups of anoxygenic prokaryotic phototrophs will be introduced as examples of organisms that are able to use light energy with only one instead of two photosystems. Different light harvesting structures (phycobilisomes, light harvesting complexes from proteobacteria, chlorosomes) and their regulation depending on environmental conditions will be discussed. Alternative electron donors (reduced sulhfur compounds, organic compounds, hydrogen etc.) for photosynthesis and alternative carbon dioxide fixation pathways (reverse TCA cycle, reductive acetyl-CoA pathway, hydroxypropionate pathway) could be subjects for a practical course, a seminar, and/or be presented as parts of a lecture.

PHPR	**Phototrophic Prokaryotes**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Seminar - Electron donors and carbon dioxide fixation pathways in phototrophic prokaryotes (12) Lab Course - Phototrophic prokaryotes (12)	2 6	60 240	2 8
Prüfung(en)		benotet/unbenotet		
	Written examination Oral presentation, protocol to the excercises	Graded (50%) Graded (50%)		
Studienleistungen	Regular participation in lab course	benotet/unbenotet		
u.a. als Zulassungs-voraussetzung zur Modulprüfung				
Sonstiges	Recommended Reading			

Colloquium Reports in the Plant Sciences				universitätbonn
Modulnummer **CRPS**	Workload **240 h**	Umfang **8 CP**	Dauer Modul **1 - 3 Semester**	Turnus **SS/WS**
Modulbeauftragter	PD Dr. Rochus Franke, Prof. Dr. Volker Knoop, AOR Dr. Jens Mutke			
Anbietende Lehreinheit(en)	alle pflanzenwissenschaftlichen Institute			
Beteiligte Dozenten	Eingeladene Gastdozenten			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahl	1 bis 3

Lernziele	The CRPS module is intended to motivate active participation in public presentations of novel plant research by invited guest speakers. Student's shall learn a) how to follow an oral scientific presentation in a concentrated manner, b) gain impressions on different styles of presentation and adapt, learn and iumpove their own style of presentation and c) ideally learn to formulate questions or contributions for subsequent discussions and d) summarize oral/visual presentations in the concise abstract-style of scientific publications.
Schlüsselkompetenzen	Concise and precise summarizing of scientific facts, results and presentations in precise writing accompanied by additional background and literature searches.
Inhalte	Student's will visit invited guest speakers' presentations on recent novel findings in the modern plant sciences such as those of the Bonn Botanical colloquium series or similar series of invited talks in the area such as the Max-Planck Institute Cologne, Forschungszentrum Jülich, Universities Aachen, Cologne or Düsseldorf. Each participation will be signed on a student's report card by the inviting scientist at the respective host institute.

CRPS	**Colloquium Reports in the Plant Sciences**			
Teilnahme-voraussetzungen	None.			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Visiting a minimum of 8 invited scientific presentations	-	240	8
Prüfung(en)		benotet/unbenotet		
	See below. Reports will be inspected and independently graded by two academic staff regularly teaching in the Plant Sciences course series. No further examination			
Studienleistungen u. a. als Zulassungs-voraussetzung zur Modulprüfung	Min. seven written abstract-style summaries of approx. 300 words each, plus one longer elaboration (of ca. 2 pages) on one selected of the above (min. 8) presentations.	benotet/unbenotet		
		Graded		
Sonstiges				

Ecophysiology of plant metabolism: photosynthesis and growth				universitätbonn
Modulnummer **ECPM**	Workload **150 h**	Umfang **5 CP**	Dauer Modul **1 Semester**	Turnus **WS**
Modulbeauftragter	Dr. Uwe Rascher			
Anbietende Lehreinheit(en)	Forschungszentrum Jülich			
Beteiligte Dozenten	Dr. Uwe Rascher, Dr. Walter, Prof. Dr. U. Schurr			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	1 or 3

Lernziele	This practical course will give the students a sound introduction on: - gas-exchange measurements to quantify respiration, photosynthesis, photorespiration and water use efficiency - chlorophyll fluorescence techniques to quantify photosynthetic efficiency of light reaction and non-photochemical energy dissipation; imaging techniques and advance approaches to understand the spatio-temporal variations of photosynthesis - methods to monitor plant structure and growth in the context of varying environmental conditions. The applied methods will range from rapid measurements of basic parameters to online image sequence analysis of growth dynamics. The analyses will elucidate the interaction of plant structure and function by studying features and parameters such as: modular arrangement of organs; location and structure of vascular tissue; relative growth rate of leaf area; dynamics of substance allocation. - classical and modern methods to quantify growth rates of and flux rates within plants - the way ecological factors are affecting plant growth and structure
Schlüsselkompetenzen	Laboratory techniques in modern plant research. Skills for documentation and presentation of scientific experiments and data.
Inhalte	In this course we will highlight the interplay between energy metabolism of photosynthesis and substrate allocation of growth processes from the single leaf to the complex 3-dimensional canopy. Photosynthesis is a dynamically regulated process. Efficiency of photosynthesis greatly varies among different plants and adapts to environmental constraints. Gas-exchange and chlorophyll fluorescence techniques have become widely used tools to characterize photosynthetic performance in time and space from the level of single leaves to the ecosystem. Abiotic and biotic factors also affect plant growth and transport. Growth processes are highly regulated adapting the structure of the plant as a whole to the ever changing environmental constraints to optimize sink-source-relationships; life cycles, life forms of higher plants and substrate efficiency.

ECPM	**Ecophysiology of plant metabolism: photosynthesis and growth**			
Teilnahme-voraussetzungen	Any PBPM module			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h]	LP
	Integrated Lab Course & Seminar (12) Ecophysiology of plant metabolism: Photosynthesis and Growth	5	150	5
Prüfung(en)		benotet/unbenotet		
	Oral and/or poster presentation	Graded		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung		benotet/unbenotet		
Sonstiges	Recommended Reading Schulze E.-D., Beck E., Müller-Hohenstein K. (2002) Pflanzenökologie. 1. Auflage, Spektrum Akademischer Verlag, Heidelberg · Berlin (auch in englischer Sprache vorhanden) Schulze, Caldwell (1996) Ecophysiology of Photosynthesis. Springer Verlag Berlin · Heidelberg · New-York Pearcy, Ehleringer, Mooney, Rundel (2000) Plant Physiological Ecology. Kluwer Academic Publishers, Dordrecht · Boston · London			