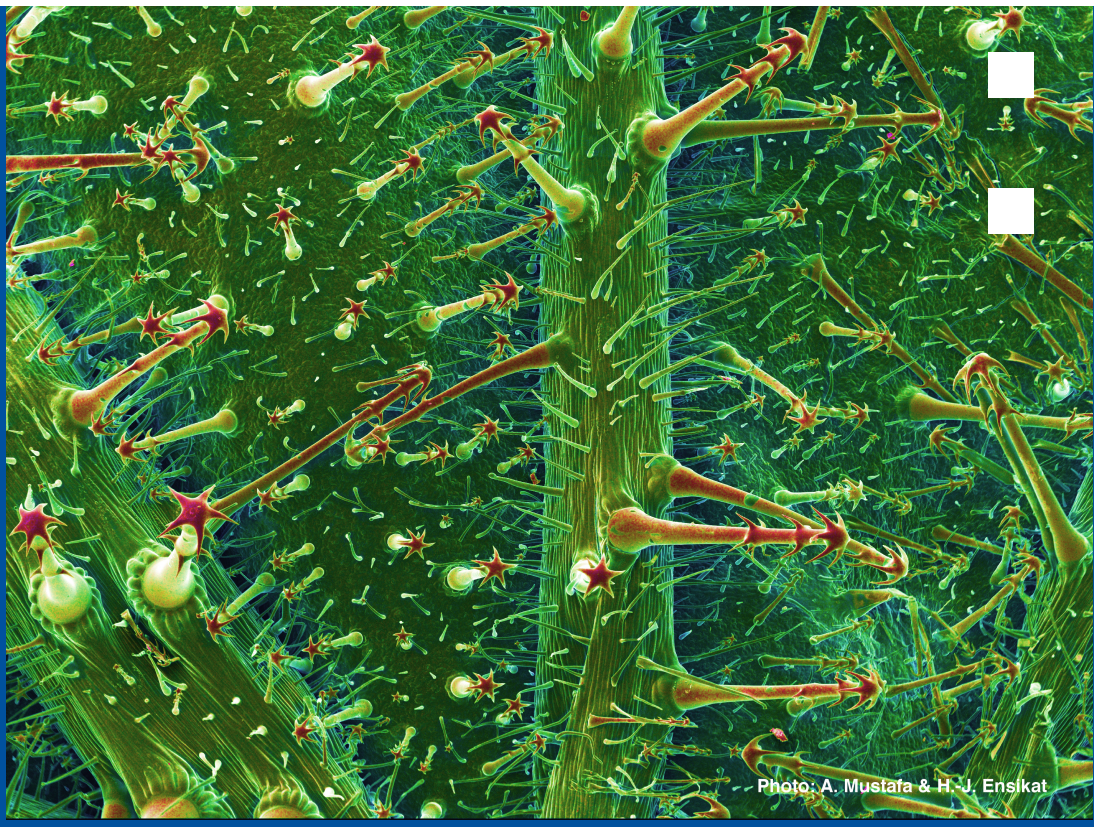
universitätbonn

M.Sc. Plant Sciences

Module description



Rheinische
Friedrich-Wilhelms-
Universität Bonn

UNIVERSITÄT BONN

Modulhandbuch

Masterstudiengang (M. Sc.)

“Plant Sciences”

Fassung für Sommer 2026

Erläuterungen

- Im folgenden **Stundenplankonzept** sind die Module des Masterstudiengangs Plant Sciences nach Kategorien farbcodiert dargestellt:
  A – Pflichtvorlesungen: Rot
  B – Theoretische Wahlpflichtmodule (z.B. Seminare): Blau
  C – Praktische Wahlpflichtmodule (Laborkurse): Grün.
  D – Frei wählbare Module (Laborkurse, Integrierte Module): Grau.
  C – Individuelle und externe Wahlmodule (Internships, externe Vorlesungen, Seminare, Praktika): Grau.

  Die Anzahl zur Verfügung stehender Plätze ist angegeben, ggf. hinter dem ‚+' die Anzahl für den Masterstudiengang OEP-Biology vorgehaltener Plätze.
- 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 in den vorlesungsfreien Zeiten.
- **Theoriemodule** mit semesterbegleitenden Vorlesungen und Seminaren in der Zeit vor 10:00h oder nach 17:00 h decken entweder **TF1-3** im Winter oder **TF5-7** im Sommer ab. Seminare finden auch Blockweise in TF4 oder TF8 statt.
- **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.

Studienverlaufsplan und Stundenplankonzept

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

Ein typisches Studienkonzept sieht wie folgt aus:

Winter Term 1 (October-March)	Lecture Modules Category A Organismic Botany 1 Plant Biochemistry, Physiology and Molecular Botany	12 CP	≥25 CP
	Theory Modules from Category B (choice)	3-6CP	
	Laboratory Module from Category C (choice)	10	
Summer Term 1 (April-September)	Lecture Modules Category A Organismic Botany 2 Plant Genetics, Morphology and Cell Architecture	12 CP	≥35 CP
	Theory Modules from Category B (choice)	3-6 CP	
	Laboratory Module from Category C (choice)	10 CP	
	Free Choice modules from Category D/E	10 CP	
Winter Term 2 (October-March)	Free Choice Modules from Category D/E – Internships / Lab Courses at external institutions	10 CP	30 CP
	Laboratory Module from Category C (choice)	20 CP	
Summer Term 2 (April-September)	Master Thesis	30 CP	30 CP
		120 CP	

Der gebundene Wahlpflichtbereich mit den Pflichtmodulen aus Bereich A und je mindestens drei Wahlpflichtmodulen aus dem theoretischen Bereiche B und dem Praxisbereich C umfasst insgesamt mindestens 63 CP.
Der freie Wahlpflichtbereich umfasst bis zu 27 CP

Compulsory Theory Modules (one each from Category A)	2 x 7 CP 2 x 5 CP	24 CP	Compulsory Choice 63 CP
Obligatory Choice Theory Modules (three or more in Category B)	3 x 3 CP	9 CP	
Obligatory Choice Practical Modules (three or more in Category C)	3 x 10 CP	30 CP	
Additional and Free Choice Modules from Category C, D or E	(0-3) x 10 CP	0-30 CP	Free Choice 27 CP
E: Internships, lab courses, practical courses at non-university external institutions (Industry, MPI et c.)	(1-2) x 10 CP	0-20 CP	
E: Any appropriate modules in Plant Sciences in accredited course programmes of the EU		0-10 CP	
E: Any appropriate modules in related natural sciences (e.g. Geo and Life sciences) in accredited course programmes of the EU		0-10 CP	
E: Any appropriate modules in other related sciences (e.g. economics, law) in accredited course programmes of the EU		0-10 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	*LEC* ***OB1***^{obl}				5
	LEC ***PBPM0***^{obl}				7
	SEM ***PBPM1, PBPM2, PBPM3, PLDE***$_{sem}$***, PLSM***			PBDC	6
	PBB	PCE	MBRE		10-20
	PPCB	APTO	PLCS		
	PBCO1	PBCO2			
		GAPB		PBEC	
				FREE1	
				FREE2	
				regular credit points 1st term:	25-38
2	*LEC* ***OB2***^{obl}				5
	LEC ***PGMA***^{obl}				7
	SEM ***PLOS, PMBG***			***PSBE***	3
	PFLS	MCPB	PBB		10-30
	SORT	PMSA	TPP		
	MEMO	PBIO	PAPA		
		SBLF	PBEC	FREE1	
				FREE2	
	CRPS				5
				regular credit points 2nd term:	25-35
3					
	PBB	PCE	MBRE	PBDC	20-30
	PPCB	APTO	PLCS		
	PBCO1	PBCO2			
		GAPB		PBEC	
				FREE1	
				FREE2	
	CRPS				5
				regular credit points 3rd term:	20-30
4	**Master Thesis Work**				30
				Credit point total:	120+

- Colour coding indicates subject categories: A) Obligatory Lecture Modules (red), B) Obligatory Choice Theory Modules (blue), C) Obligatory Choice Lab Modules (green) and D/E) Free Choice Modules (grey).
- All lecture modules from category A (OB1, OB2, PBPM and PGMA) + a minimum of three theory modules from B + a minimum of three lab modules from C are obligatory.
- Any further modules of the categories B and C or additional modules from D and E may be chosen freely, only depending on time frame compatibility.

Hence, an exemplary student's module program may be, for example:
1st term: OB1 + LEC PBPM0 + SEM PBPM2 + PBCO1 + APTO = 30 CP
2nd term: OB2 + PGMA + PLOS + SORT + PAPA = 30 CP
3rd term: PBB + PCE + MBRE (or FREE2) = 30 CP
4th term: Master thesis = 30 CP
resulting in a total of: 120 CP (min. requirement)

An alternative student's module program may be, for example:

1st term: OB1 + LEC PBPM0 + SEM PBPM3 + PLSM + PBB	= 28 CP
2nd term: OB2 + PGMA + PLOS + MCPB + TPP	= 35 CP
3rd term: PHPR + GAPB + CRPS + APTO	= 27 CP
4th term: Master thesis	= 30 CP

resulting in a total of: 120 CP (min. requirement)

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 Lecture Modules						
PBPM0	LEC: Plant Biochemistry, Physiology and Molecular Biology	Maurino, Schreiber, N.N.	IZMB	7	W	30
OB1	LEC: Organismic Botany 1 – Plant Systematics and Biodiversity	Weigend, Quandt	BIOB Abt 1	5	W	30
OB2	LEC: Organismic Botany 2 – Vegetation and Plant Ecology	Weigend m. Mutke	BIOB Abt 1	5	S	30
PGMA	LEC: Plant Genetics, Morphology and Cell Architecture	Dörmann, Vothknecht	IMBIO, IZMB	7	S	30
B: Obligatory Choice Theory Modules (at least three, min. 9 CP, max. 15 CP)						
PBPM1	SEM: Plant Molecular Physiology and Technology	Maurino	IZMB	3	W	15
PBPM2	SEM: Plant Bioinformatics and Genomics	Pucker	IZMB	3	W	15
PBPM3	SEM: Ecophysiology	Schreiber	IZMB	3	W	15
PLSM	SEM: Plant Secondary Metabolism	Vothknecht	IZMB	3	W	15
PBDC	SEM: Plant Biodiversity and Conservation	Mutke, Löhne	BIOB Abt 1	3	W	15 (+5)
PSBE	SEM: Diversity, Systematics and Evolution of Plants	Weigend, Quandt	BIOB Abt 1	3	S	15 (+5)
PLOS	SEM: Plant Organelles –Structure and Function	Chigri	IZMB	3	S	15
PMBG	SEM: Plant Molecular Biology and Genetics	Dörmann	IMBIO	3	S	15
C: Obligatory Choice Lab Modules (at least three, min 30 CP)						
PCE	LAB: Physiological and Chemical Ecology	Franke	IZMB	10	W	8
APTO	LAB: Applied Plant Transcriptomics	Pucker	IZMB	10	W	12
PLCS	LAB: Plant Cellular Signalling	Chigri	IZMB	10	W	15
PPCB	LAB: Plant Physiology and Cell Biology	Dörmann	IMBIO	10	W	12
MBRE	LAB: Modern Biodiversity Research: from population genetics to phylogenomics	Quandt	BIOB Abt 1	10	W	8 (+2)
PBCO1	LAB: GIS for Plant Biogeography & Conservation	Mutke	BIOB Abt 1	5	W	6 (+6)
PBCO2	LAB: Biodiversity Informatics: Data analyses for ecology and biogeography	Mutke	BIOB Abt 1	5	W	6 (+6)
PBB	LAB: Protein Biochemistry and Biotechnology	Maurino	IZMB	10	W,S	12
MCPB	LAB: Molecular Cell Physiology & Biotechnology	Dörmann	IMBIO	10	S	12
TPP	LAB: Transport Physiology	Schreiber	IZMB	10	S	12
PMSA	LAB: Plant Morphology and Structural Adaptation	Vothknecht	IZMB	10	S	8

SORT	LAB: Plant Gene Expression and Protein Sorting	Frank	IZMB	10	S	8
PFLS	LAB: Python for Life Scientists	Pucker	IZMB	10	S	15 (+*)
PBIO	LAB: Systematics and Biology of Seed Plants	Weigend (Quandt) m. N.N.	BIOB Abt 1	10	S	16
MEMO	LAB: Mechanistic ecological modelling	Sarmento Cabral	BIOB Abt 1	5	S	6 (+6)
SBLF	LAB: Systematic and Biology of Lycophytes and Ferns ((incl. Excursion)	Quandt	BIOB Abt 1	5	S	6 (+6)
D: Free Choice Modules						
PBEC	LAB: Vegetation Ecology (incl. Excursion)	Quandt / Weigend / N.N.	BIOB Abt 1	5/10*	W or S	8 (+7)
PAPA	INT: Paleobotany & Palynology	Litt	IfP	5	S	10 (+5)
PRHS (MA-P-06)	INT: Plant Redox Homeostasis and Signalling	Meyer	INRES	6	W	24
GAPB (MA-P-33)	INT: Genome Analysis in Plant Breeding	Mason m. Ballvora	INRES	6	W	6 (+6)
CRPS	LEC: Colloquium Reports in the Plant Sciences	N.N.	IZMB	5	S	15
E: Individual and External Free Choice Modules in the Plant Sciences (regularly or on individual agreement)						
FREE1	Any appropriate modules in Plant Sciences which are part of an accredited course program at a university within the EU.			Max. 10 CP	Any TF	
FREE2	Practical lab research, courses or internships agreed upon on an individual basis with plant research groups in university or external research institutions.			Max. 20 CP	Any TF	
FREE3	Any appropriate modules in related natural sciences (e.g. Geo Sciences, Biochemistry, Pharmacology etc.), 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 etc.), which are part of an accredited course program at a EU university upon application.			Max. 10 CP	Any TF	

*5 or 10 CP depending on duration of excursion

Obligatory Lectures

Plant Biochemistry, Physiology and Molecular Biology				UNIVERSITÄT BONN
Modulnummer **638130010**	Workload **210 h**	Umfang **7 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **WS**
Modulbeauftragter	Prof. Dr. Lukas Schreiber			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	Prof. Dr. Boas Pucker Prof. Dr. Veronica Maurino 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. 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.			

PBPM	**Plant Biochemistry, Physiology and Molecular Biology**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Lecture - Plant Biochemistry, Physiology and Molecular Biology (60)	3	210 20 / 80	7
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Written examination (3 Hours)	Graded (100%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	None	benotet/unbenotet		
Sonstiges	Recommended Reading Taiz L, Zeiger E (2006) Plant Physiology. Sinauer Associates Inc., Sunderland, MA Bob B. Buchanan, Wilhelm Gruissem, and Russel L. Jones. Biochemistry and Molecular Biology of Plants. 2nd ed. Rockville, MD:American Society of Plant Physiologists, 2015. Russel Jones, Helen Oughma, Howard Thomas and Susan Waaland. The Molecular Life of Plants. West Sussex:Wiley-Blackwell, 2012			

Organismic Botany 1: Plant Systematics and Biodiversity				UNIVERSITÄT BONN
Modulnummer **638130020**	Workload **150 h**	Umfang **5 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **WS**
Modulbeauftragter	Prof. Dr. Maximilian Weigend			
Anbietende Lehreinheit(en)	FG Biologie, BIOB, Abt. 1			
Beteiligte Dozenten	Prof. Dr. Maximilian Weigend, Prof. Dr. Dietmar Quandt			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Pflicht	1
	M. Sc. OEP Biology	Pflicht	1
	M. Sc. Naturschutz und Landschaftsökologie	Wahlpflicht	1 o. 3

Lernziele	At the end of the module students should have a sound overview about the major lineages and families of plants (especially seed plants), their systematics, morphology, and basic ecology. They will have a good background in morphology, taxonomy, and systematics.
Schlüsselkompetenzen	Advanced understanding of plant biodiversity including a good understanding of morphology, taxonomy, and systematics.
Inhalte	The lecture teaches systematics, morphology and ecology of plants with an emphasis on the systematics, diversity and evolution of flowering plants. Introductory lectures cover cryptogams and gymnosperms. The lecture incorporates recent insights from the field of molecular systematics. Seed plants are the most important structural elements and primary producers in most terrestrial ecosystems. They produce food, medicine, and technical products for the over 7 Billion people.

<table>
<tr><td>OB1</td><td colspan="4">Organismic Botany 1: Plant Systematics and Biodiversity</td></tr>
<tr><td>Teilnahme-voraussetzungen</td><td colspan="4">None</td></tr>
<tr><td>Veranstaltungen</td><td>Lehrform, Titel (Teilnehmer)</td><td>SWS</td><td>Workload [h]
% presence /self learning</td><td>LP / ECTS</td></tr>
<tr><td></td><td>Lecture - Plant Systematics and Biodiversity (30)</td><td>2</td><td>150
20 / 80</td><td>5</td></tr>
<tr><td rowspan="2">Prüfung(en)
Art, Umfang, Dauer</td><td></td><td colspan="3">benotet/unbenotet</td></tr>
<tr><td>Written examination (45 min)</td><td colspan="3">Graded</td></tr>
<tr><td>Studienleistungen
u.a. als Zulassungs-voraussetzung zur Modulprüfung</td><td rowspan="2">None</td><td colspan="3">benotet/unbenotet</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>Sonstiges</td><td colspan="4">Recommended Reading

JUDD, W.S., CAMPBELL, C.S., KELLOG, E.A. & STEVENS, P.F. : 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.
KADEREIT, J.W., KÖRNER, C.,KOST, B., SONNEWALD, U.: Strasburger Lehrbuch der Pflanzenwissenschaften. - Springer Spektrum.</td></tr>
</table>

Organismic Botany 2: Vegetation and Plant Ecology				UNIVERSITÄT BONN
Modulnummer **638130330**	Workload **150 h**	Umfang **5 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **SS**
Modulbeauftragter	Prof. Dr. Maximilian Weigend			
Anbietende Lehreinheit(en)	FG Biologie, BIOB, Abt. 1			
Beteiligte Dozenten	Prof. Dr. Maximilian Weigend			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Pflicht	2
	M. Sc. OEP Biology	Wahlpflicht	2
	M. Sc. Naturschutz und Landschaftsökologie	Wahlpflicht	2

Lernziele	By the end of the modul, the students should have a sound understanding of the influence of the abiotic environment on plant communities and vegetation structure. They should be able to map the distribution and describe the nature of earth's major terrestrial biomes. They should have a basic understanding of anthropogenic influence on terrestrial ecosystems.
Schlüsselkompetenzen	Advanced understanding of plant ecology in the context of the terrestrial ecosystems.
Inhalte	The course deals with the field of vegetation ecology. This includes an introduction to global vegetation geography. The factors influencing plant dispersal, establishment and distribution and the composition of vegetation units including human influence on terrestrial ecosystems are presented. The characteristic plant groups for specific ecosystems are introduced and their ecological characteristics discussed.

OB2	**Organismic Botany 2: Vegetation and Plant Ecology**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Lecture - Plant Ecology and Vegetation (30)	2	150 20 / 80	5
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Written examination (45min)	Graded		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	None	benotet/unbenotet		
Sonstiges	Recommended Reading LOMOLINO, RIDDLE, WHITTAKER & BROWN. Biogeography, Sinauer. MILLINGTON, BLUMLER & SCHICKHOFF (eds.). Handbook of Biogeography. Sage Publications: London FREY & LÖSCH : Lehrbuch der Geobotanik. Elsevier, Spektrum Verlag. SCHULZE, BECK & MÜLLER-HOHENSTEIN: Plant Ecology. Springer. 702 pp WALTER & BRECKLE: Vegetationszonen und Klima. UTB, Ulmer, Stuttgart KADEREIT, J.W., KÖRNER, C.,KOST, B., SONNEWALD, U.: Strasburger Lehrbuch der Pflanzenwissenschaften. - Springer Spektrum.			

Plant Genetics, Morphology and Cell Architecture				UNIVERSITÄT BONN
Modulnummer **638130030**	Workload **210 h**	Umfang **7 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **SS**
Modulbeauftragter	Prof. Dr. Ute Vothknecht			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	Prof. Dr. Ute Vothknecht Prof. Dr. Peter Dörmann			

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

Lernziele	Students should gain a solid understanding of the evolution of the plant cell, the genetic basis of plant development and function as well as the fundamental principles of plant cell architecture.
Schlüsselkompetenzen	Understanding of plant specific aspect of DNA replication, gene transcription and translation. Advanced understanding of plant structure-function relationships on a morphological and cellular level.
Inhalte	The lecture by Prof. Dörmann will cover the basic principles of molecular biology of eukaryotic cells with a focus on plants, including the storage of DNA in the nucleus, mitochondria, chloroplasts; replication, transcription, translation; protein translocation to other organelles; posttranslational modification. We will discuss the fertilization process, Mendalian laws, heterosis effect and hybrid breeding, production of near isogenic lines and recombinant inbred lines, GWAS and QTL mapping. The lecture by Prof. Vothknecht will address the genetic basis of plant development as well as the structure and function of different plant cells, tissues and organs from morphology, to microscopic anatomy to the level of macromolecular interactions. The lecture will include: replication, transcripton and translation; endosymbiont theory and the emergence of plant cell lineages; plastid types; biomembranes and membrane-delinated organelles; the cytoskeleton and the structural framework of the cell; cell differentiation, cell-to-cell communication and signaling; principles of the plant cell cycle; plant movement.

PGMA	**Plant Genetics, Morphology and Cell Architecture**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Lecture - Plant Cell Biology and Adapation (60)	3	210 20 / 80	7
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Written examination	Graded (100%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	None	benotet/unbenotet		
Sonstiges	Recommended Reading Corresponding chapters in Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, and Peter Walter. Molecular biology of the cell. 6th ed. New York:Garland Science, 2015. Bob B. Buchanan, Wilhelm Gruissem, and Russel L. Jones. Biochemistry and Molecular Biology of Plants. 2nd ed. Rockville, MD:American Society of Plant Physiologists, 2015. Russel Jones, Helen Oughma, Howard Thomas and Susan Waaland. The Molecular Life of Plants. West Sussex:Wiley-Blackwell, 2012			

Obligatory Choice Theory Modules

PBPM1 - Plant Molecular Physiology and Technology				UNIVERSITÄT BONN
Modulnummer **638130040**	Workload **90 h**	Umfang **3 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **WS**
Modulbeauftragter	Prof. Dr. Veronica Maurino			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	Prof. Dr. Veronica Maurino			

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.
Inhalte	The 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	**PBPM1 - Plant Molecular Physiology and Technology**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Seminar - Plant Molecular Physiology & Biotechnology (15)	2	90 20 / 80	3
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Referat - Oral presentation (30 min)	Graded (100%)		
Studienleistungen	Regular participation in seminar	benotet/unbenotet		
u.a. als Zulassungs-voraussetzung zur Modulprüfung				
Sonstiges	Recommended Reading Taiz L, Zeiger E (2006) Plant Physiology. Sinauer Associates Inc., Sunderland, MA Bob B. Buchanan, Wilhelm Gruissem, and Russel L. Jones. Biochemistry and Molecular Biology of Plants. 2nd ed. Rockville, MD:American Society of Plant Physiologists, 2015. Russel Jones, Helen Oughma, Howard Thomas and Susan Waaland. The Molecular Life of Plants. West Sussex:Wiley-Blackwell, 2012			

PBPM2 - Plant Bioinformatics and Genomics				UNIVERSITÄT BONN
Modulnummer **638130052**	Workload **90 h**	Umfang **3 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **WS**
Modulbeauftragter	Prof. Dr. Boas Pucker			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	Prof. Dr. Boas Pucker			

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

Lernziele	Students will gain a solid understanding of key concepts and current methods in plant bioinformatics and genomics.
Schlüsselkompetenzen	Developing skills in searching, reading, and interpreting scientific literature and databases; effectively presenting scientific data both visually and orally; and engaging in the discussion of scientific concepts and results.
Inhalte	This seminar provides an in-depth exploration of recent advances in plant bioinformatics and genomics through critical review of current literature. Students will study bioinformatic approaches for analyzing genomic and transcriptomic datasets, including sequencing workflows, genome assembly and annotation methods, and the use of long-read sequencing technologies. The seminar also covers the integration of multi-omics data and addresses challenges in data interpretation and analysis. By engaging with cutting-edge research papers, students will develop a strong theoretical understanding of contemporary methodologies and their applications in plant genomics.

PBPM2	**PBPM2 – Plant Bioinformatics and Genomics**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Seminar - Plant Bioinformatics and Genomics (15)	2	90 20 / 80	3
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Referat - Oral presentation (10 min)	Graded (100%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Portfolio	benotet/unbenotet		
Sonstiges	Recommended Reading Pucker B, Irisarri I, de Vries J and Xu B (2022). Plant genome sequence assembly in the era of long reads: Progress, challenges and future directions. Quantitative Plant Biology, 3, E5. doi: 10.1017/qpb.2021.18 de Oliveira, J. A. V. S.; Choudhary, N.; Meckoni, S. N.; Nowak, M. S.; Hagedorn, M.; Pucker, B. (2025). Cookbook for Plant Genome Sequences. doi: 10.20944/preprints202508.1176.v1			

PBPM3 - Ecophysiology				UNIVERSITÄT BONN
Modulnummer **638130060**	Workload **90 h**	Umfang **3 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **WS**
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	1 oder 3

Lernziele	Students should gain a solid understanding of plant/environment interactions and how plants respond to various environmental factors. This includes molecular and physiological processes induced in response to biotic and abiotic factors.
Schlüsselkompetenzen	Searching, reading and understanding of scientific literature and databases. Skills for visual and oral presentation of scientific data. Advanced understanding of plant ecophysiology.
Inhalte	The seminar "Ecophysiology" PBPM3 will cover various aspects of the interactions of plants with the environment. This includes the effects of abiotic and biotic environmental factors on plants and the corresponding plant responses from the molecular to the organismic level.

PBPM3	**PBPM3 - Ecophysiology**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Seminar - Ecophysiology (15)	2	90 20 / 80	3
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Referat - Oral presentation (30 min)	Graded (100 %)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in seminar	benotet/unbenotet		
Sonstiges	Recommended Reading Taiz L, Zeiger E (2006) Plant Physiology. Sinauer Associates Inc., Sunderland, MA Bob B. Buchanan, Wilhelm Gruissem, and Russel L. Jones. Biochemistry and Molecular Biology of Plants. 2nd ed. Rockville, MD:American Society of Plant Physiologists, 2015. Russel Jones, Helen Oughma, Howard Thomas and Susan Waaland. The Molecular Life of Plants. West Sussex:Wiley-Blackwell, 2012			

PMBG - Plant Molecular Biology and Genetics				UNIVERSITÄT BONN
Modulnummer **638130100**	Workload **90 h**	Umfang **3 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **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	Students shall learn how to prepare a presentation using scientific literature and other information available in the internet. How do you organize an oral presentation? How do you transport the main message to your audience? How do you explain complex molecular information?			
Schlüsselkompetenzen	Searching, reading and understanding of scientific literature and databases. Skills for visual and oral presentation of scientific data. Advanced understanding ….			
Inhalte	The seminar will cover the principles of plant molecular biology and genetics. The flow of genetic information (DNA, RNA, protein) including DNA replication, transcription, translation will be discussed. DNA is stored in different organelles of the cell. Chromosomes harbor the nuclear genome. How are proteins synthesized in the cytosol and transferred to different organelles? How are proteins modified posttranslationally? What are RILs and NILs? How do you map a gene? Heterosis as the basis for hybrid breeding.			

PMBG	PMBG - Plant Molecular Biology and Genetics			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Seminar -Plant Molecular Biology and Genetics (15)	2	90 20 / 80	3
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Referat - Oral presentation (30 min)	Graded (100 %)		
Studienleistungen	Regular participation in seminar	benotet/unbenotet		
u.a. als Zulassungs-voraussetzung zur Modulprüfung		not graded		
Sonstiges	Buchanan, Gruissem, Jones: Biochemistry and Molecular Biology of Plants, John Wiley & Sons Inc, ISBN 978-0-470-71421-8			

PLOS: Plant Organelles - Structure and Function				UNIVERSITÄT BONN
Modulnummer **638130090**	Workload **90 h**	Umfang **3 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **SS**
Modulbeauftragter	Dr. Fatima Chigri			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	Dr. Fatima Chigri			
Verwendbarkeit des Moduls	Studiengang		Modus	Studiensemester
	M. Sc. Plant Sciences		Wahlpflicht	2
Lernziele	Students will gain an advanced understanding of the structure and function of plant organelles. They are exposed to English-language literature in this field and can advance their skills in presenting a topic comprehensively to a group and discussing a scientific topic in the English language.			
Schlüsselkompetenzen	Searching, reading and understanding of scientific literature. Skills for visual and oral presentation of scientific data. Discussion of scientific concepts and data.			
Inhalte	The seminar will focus and membrane-delineated plants organelles with a special focus on their structure and plant-specific functions. Students will be introduced to the various roles that cell organelles full-fill in different tissues and in respect to different cellular processes. They will further learn that the cooperation of multiple compartments is required for most cellular functions.			

PLOS	**Plant Organelles - Structure and Function**			
Teilnahme-voraussetzungen	none			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Seminar - Plant Signaling and Regulation (15)	2	90 20 / 80	3
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Active participation in discussion Referat - Oral presentation	Graded (40%) Graded (60%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in seminar series and oral presentation	benotet/unbenotet		
Sonstiges	Recommended Reading Finding of appropriate literature by the students is part of the competence to be acquired within the seminar.			

Plant Secondary Metabolism				UNIVERSITÄT BONN
Modulnummer **638130070**	Workload **90 h**	Umfang **3 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **WS**
Modulbeauftragter	Prof. Dr. Ute Vothknecht			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	Prof. Dr. Ute Vothknecht			

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

Lernziele	Students are introduced to the general function of secondary metabolites in plants, including a short historical account on the use of plants as medicines and recreational drugs.
Schlüsselkompetenzen	Searching, reading and understanding of scientific literature. Skills for visual and oral presentation of scientific data. Discussion of scientific concepts and data.
Inhalte	Secondary metabolites are not essential for general plant survival, but they play an important role in adaption to specific environmental conditions, especially for attraction of pollinators and seed distributors or to defend against herbivores, pathogens or unwanted feeders. A broad overview over the different classes of secondary metabolites that are produced by various plants will be presented and specific roles of certain secondary metabolites will be discussed.

PLSM	**Plant Secondary Metabolism**			
Teilnahme-voraussetzungen	none			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	INT (Lecture & Seminar - Plant Secondary Metabolism (15)	2	90 20 / 80	3
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Active participation in discussion Referat - Oral presentation	Graded (40%) Graded (60%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in seminar series and oral presentation	benotet/unbenotet		
Sonstiges	Recommended Reading Angelika Böttger, Ute C. Vothknecht, Cordelia Bolle, Alexander Wolf. Lessons on Caffeine, Cannabis & Co. Learning Materials in Bioscience. Springer Nature Switzerland 2018 Herwig O. Gutzeit, Jutta Ludwig-Müller. Plant Natural Products. Wiley-VCH Verlag GmbH & Co 2014			

PSBE - Diversity, Systematics and Evolution of Plants				UNIVERSITÄT BONN
Modulnummer **638130320**	Workload **90 h**	Umfang **3 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **SS**
Modulbeauftragter	Prof. Dr. Maximilian Weigend, Prof. Dr. Dietmar Quandt			
Anbietende Lehreinheit(en)	FG Biologie, BIOB, Abt. 1			
Beteiligte Dozenten	Prof. Dr. Maximilian Weigend, Prof. Dr. Dietmar Quandt u. 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 seed plants), 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, including conservation biology. They have familiarized themselves with current advances in the field and have a rough overview of the scientific literature on the topics.
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	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 7 billion people. Sound understanding of the phylogeny and evolution of plants helps to better understand both their ecological adaptations as well as the origin of crops and medicinal plants. Recent as well as fundamental publications on plant biodiversity, systematics, and evolution will be presented by the students and discussed during the seminar.

PSBE	**Diversity, Systematics and Evolution of Plants**			
Teilnahme-voraussetzungen	Successfull participation in OB1 Plant Systematics and Biodiversity			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Seminar - Diversity, Systematics and Evolution of Plants (18)	2	90 30 / 70	3
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Referat - Oral presentation (30 min)	Graded		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in the seminar	benotet/unbenotet		
Sonstiges	Recommended Reading JUDD, W.S., CAMPBELL, C.S., KELLOG, E.A. & STEVENS, P.F. : 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. KADEREIT, J.W., KÖRNER, C.,KOST, B., SONNEWALD, U.: Strasburger Lehrbuch der Pflanzenwissenschaften. - Springer Spektrum.			

Plant Biodiversity and Conservation				UNIVERSITÄT BONN
Modulnummer **638130360**	Workload **90 h**	Umfang **3 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **WS**
Modulbeauftragter	Prof. Dr. Maximilian Weigend			
Anbietende Lehreinheit(en)	FG Biologie, BIOB, Abt. 1			
Beteiligte Dozenten	Prof. Dr. Maximilian Weigend Dr. Jens Mutke, Dr. Cornelia Löhne			

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

Lernziele	By the end of the seminar, the students have a first overview about conservation biology and related (international) agreements and organisations.
Schlüsselkompetenzen	Searching, reading and understanding of scientific literature and databases. Skills for visual and oral presentation of scientific data. Sound overview on approaches, programs, and actors in biodiversity conservation.
Inhalte	The Seminar gives an introduction to basic concepts and approaches of nature conservation. A major focus will be on the international agreements and actors related to conservation of biological diversity.

PBDC	**Plant Biodiversity and Conservation**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Seminar - Biodiversity and Conservation (15)	2	90 30 / 70	3
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Referat - Oral presentation (20 min)	Graded		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular and active participation in the seminar	benotet/unbenotet		
Sonstiges	Recommended Reading PRIMACK: Essentials of Conservation Biology.Sinauer. https://www.bfn.de/en/activities/international-nature-conservation.html UNEP: Global Environmental Outlook.			

Obligatory Choice Lab Modules

Modern Biodiversity Research: from population genetics to phylogenomics				UNIVERSITÄT BONN
Modulnummer **638130300**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **WS**
Modulbeauftragter	Prof. Dr. Dietmar Quandt			
Anbietende Lehreinheit(en)	FG Biologie, BIOB, Abt. 1			
Beteiligte Dozenten	Prof. Dr. Dietmar Quandt u. Mitarbeiter			

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 (wet lab) and using computers (dry lab) for (2) contig assembly based on pherograms (Sanger sequencing) (3) genome assembly and annotation based on NGS and fourth generation data (4) alignment (5) phylogenetic reconstructions as well as (6) population genetics and (7) basics in writing and applying scripts for example in Unix, R and Python .
Schlüsselkompetenzen	Laboratory skills, molecular techniques, computational skills, statistical methods, analysis, and presentation of scientific data.
Inhalte	Our understanding of plant relationships and evolution has been revolutionized by the first angiosperm phylogeny in 1993, and the field is still developing at great pace. Thus 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 Sanger sequences to single molecule real time sequencing and beyond. Case studies deal with important groups such as angiosperms, ferns and bryophytes in greater detail.

<table>
<tr><td>MBRE</td><td colspan="4">Modern Biodiversity Research: from populuation genetics to phylogenomics</td></tr>
<tr><td>Teilnahme-voraussetzungen</td><td colspan="4">None</td></tr>
<tr><td>Veranstaltungen</td><td>Lehrform, Titel (Teilnehmer)</td><td>SWS</td><td>Workload [h]
% presence /self learning</td><td>LP / ECTS</td></tr>
<tr><td></td><td>Lab Course - Modern Biodiversity Research (8)</td><td>8</td><td>300
50 / 50</td><td>10</td></tr>
<tr><td rowspan="2">Prüfung(en)
Art, Umfang, Dauer</td><td></td><td colspan="3">benotet/unbenotet</td></tr>
<tr><td>Oral and/or poster presentation
Protocol to the excercises</td><td colspan="3">Graded (30%)
Graded (70%)</td></tr>
<tr><td>Studienleistungen
u.a. als Zulassungs-voraussetzung zur Modulprüfung</td><td rowspan="2">Regular participation in lab course</td><td colspan="3">benotet/unbenotet</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>Sonstiges</td><td colspan="4">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.
K. Weising et al. DNA Fingerprinting in Plants: Principles, Methods, and Applications. CRC Press.
R. Page & E. Holmes. Molecular Evolution - A Phylogenetic Approach. Blackwell.

Special and actual literature.</td></tr>
</table>

Geographic Information Systems (GIS) for Biogeography and Conservation				UNIVERSITÄT BONN
Modulnummer **638130270**	Workload **150 h**	Umfang **5 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **WS**
Modulbeauftragter	Dr. Jens Mutke			
Anbietende Lehreinheit(en)	FG Biologie, BIOB, Abt. 1			
Beteiligte Dozenten	Mutke, Weigend u. Mitarb.			

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

Lernziele	By the end of the module, students should be able to design and perform analyses in the fields of macroecology, biogeography, and nature conservation using GIS and spatial data analyses.
Schlüsselkompetenzen	The use of Geographic Information Systems (GIS) for mapping and spatial analyses; 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 mapping and spatial data analysis using GIS with theory and excercises from the fields of macroecology and biogeography. A special focus will be conservation biogeography including priority setting and analyses of the impact of global environmental change on biodiversity.

PBCO1	**Geographic Information Systems (GIS) for Biogeography and Conservation**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Lab Course - Geographic Information Systems (GIS) for Plant Biogeography and Conservation (6+6)	4	150 50 / 50	5
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Oral and/or poster presentation Protocol to the excercises	Graded (60%) Graded (40%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course	benotet/unbenotet		
Sonstiges	Recommended Reading LOMOLINO, RIDDLE, WHITTAKER & BROWN. Biogeography, Sinauer. MILLINGTON, BLUMLER & SCHICKHOFF (eds.). Handbook of Biogeography. Sage Publications: London PRIMACK: Essentials of Conservation Biology.Sinauer. WEGMANN et al.: Remote Sensing and GIS for Ecologists. Pelagic Publishing.			

Biodiversity Informatics: Data analyses for ecology and biogeography				UNIVERSITÄT BONN
Modulnummer **638130280**	Workload **150 h**	Umfang **5 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **WS**
Modulbeauftragter	Dr. Jens Mutke			
Anbietende Lehreinheit(en)	FG Biologie, BIOB, Abt. 1			
Beteiligte Dozenten	Mutke, Weigend u. Mitarb.			

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

Lernziele	By the end of the module, students should be able to design and perform analyses in the fields of (macro-) ecology and biogeography using mainly code-based analysis software such as R or Julia.
Schlüsselkompetenzen	Code based data analysis, skills for planning, performing, documentation, and presentation of scientific analyses.
Inhalte	This course provides an overview of methods commonly used to analyse and model data in the field of ecology (incl. macroecology) and biogeography. This includes analyses and modelling of spatial data in a geographic context (e.g. bioclimatic modelling / environmental niche models) – thus some background in the context of geographic information systems is of advantage.

PBCO2	**Biodiversity Informatics: Data analyses for ecology and biogeography**			
Teilnahme-voraussetzungen	Knowledge of basic statistics; basic knowledge of geographic information systems (GIS) is of advantage			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Lab Course - Biodiversity Informatics: Data analyses for ecology and biogeography (6+6))	4	150 50 / 50	5
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Oral and/or poster presentation Protocol to the excercises	Graded (40%) Graded (60%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course	benotet/unbenotet		
Sonstiges	Recommended Reading GUISAN et al.: Habitat Suitability and Distribution Models. Cambridge. S. QIAN: Environmental and Ecological Statistics with R, Second Edition.. CRC. WEGMANN et al.: Remote Sensing and GIS for Ecologists. Pelagic Publishing.			

Plant Biodiversity - Systematics and Biology of Plants				UNIVERSITÄT BONN
Modulnummer **638130350**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **SS**
Modulbeauftragter	Prof. Dr. Maximilian Weigend, Prof. Dr. Dietmar Quandt			
Anbietende Lehreinheit(en)	FG Biologie, BIOB, Abt. 1			
Beteiligte Dozenten	Prof. Dr. Maximilian Weigend, Prof. Dr. Dietmar Quandt, 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 over the major lineages and families of land plants, their systematics, morphology, and basic ecology. They will be familiar with the most important methods and terminology in the field of descriptive and functional 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 provides an overview on the morphology, systematics and biology (esp.., reproductive biology) of plants based primarily on living material from the botanic gardens, as well as herbarium material. Methods for the documentation and analysis of plant diversity from the fields of morphology, taxonomy, and, e.g., fruit and floral biology are taught.

PBIO	**Plant Biodiversity - Systematics and Biology of Plants**			
Teilnahme-voraussetzungen	OB1 Lecture Plant Systematics and Biodiversity			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Lab Course - Systematics and Biology of Seed Plants (12)	8	300 50 / 50	10
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Oral and/or poster presentation Protocol to the excercises (selected)	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. : 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. KADEREIT, J.W., KÖRNER, C.,KOST, B., SONNEWALD, U.: Strasburger Lehrbuch der Pflanzenwissenschaften. - Springer Spektrum			

Protein Biochemistry and Biotechnology				UNIVERSITÄT BONN
Modulnummer **638130170**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **SS / WS**
Modulbeauftragter	Prof. Dr. Veronica Maurino			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	Prof. Dr. Veronica Maurino			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	1, 2, 3 oder 4

Lernziele	The students know basic concepts and methods of protein biochemistry and biotechnology and are able to describe as well as explain the acquired knowledge of methods practically applied. The students are able to comprehend the process of the expression and purification of recombinant proteins dealing with the structure and kinetic characteristics in its single steps. The students know concepts of molecular evolution of proteins. The students are able to carry out the experiments as well as precisely document, evaluate and judge them.
Schlüsselkompetenzen	Laboratory techniques in protein research. Skills for documentation and presentation of scientific experiments and data.
Inhalte	<u>Lectures:</u> Key aspects of the theoretical part are: (i) Methods in protein biochemistry and proteomics: electrophoresis, Western blotting, immunodetection, in-gel activity assays, mass spectrometry (ii) Methods in protein biotechnology (recombinant protein technology): cloning strategies, site directed mutagenesis; heterologous protein expression and purification; (iii) Enzyme kinetics: activity assays, determination of optimum pH and kinetic constants. (iv) Molecular evolution of proteins in the example of C_4 photosynthesis. <u>Practical Course:</u> According to examples of chosen enzymes the students learn techniques in protein research. This includes the practical application of essential techniques for heterologous protein expression and purification, as well as structural and kinetic analysis. Recombinant proteins are produced in *E. coli* and purified with chromatographical methods. The isolated proteins are then structurally and kinetically characterized. In the process various biochemical techniques, such as gel filtration, electrophoresis, blotting, protein staining in-gel activity assays and absorption spectroscopy are applied.

PBB	**Protein Biochemistry and Biotechnology**			
Teilnahme-voraussetzungen	Any PBPM module			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Lab Course - Protein Biochemistry and Biotechnology (12)	8	300 50 / 50	10
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Examination (45 min) Oral presentation of practical work (20 min) Protocol of the practical work	Graded (50%) Graded (20%) Graded (30%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course (at least 80%) Oral presentation of the practical work	benotet/unbenotet		
Sonstiges	Recommended reading: Nelson, Cox: Lehninger Principles of Biochemistry Berg, Tymoczko, Stryer: Biochemistry Taiz , Zeiger: Plant Physiology			

Physiological and Chemical Ecology				UNIVERSITÄT BONN
Modulnummer **638130120**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **WS**
Modulbeauftragter	PD Dr. Rochus Franke			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	PD Dr. Rochus Franke			
Verwendbarkeit des Moduls	Studiengang		Modus	Studiensemester
	M. Sc. Plant Sciences		Wahlpflicht	1 or 3
Lernziele	In this course students learn to use a variety of different techniques used to analyse plant environment interactions. This includes methods and experimental design in analytical chemistry, molecular biology (gene expression and reporter gene fusion) and transport physiology (water and metabolite transport across plant surfaces).			
Schlüsselkompetenzen	Laboratory techniques in modern plant research. Skills for documentation and presentation of scientific experiments and data.			
Inhalte	In the lab course the role of plant diffusion barriers in plant environment interactions will be studied. *Arabidopsis thaliana* and or potato will mostly be employed as a model organism but crop species such as barley or corn will also be studied. Experimental approaches address drought and salt stress, chemical and physiological diversity and secondary plant metabolites. Experimental approaches include isolation, identification and quantification of secondary metabolites, measurement of cuticular/peridermal transpiration and transport of xenobiotics, Histochemistry, chemical analytics and analysis of gene expression in response to environmental stimuli.			

PCE	**Physiological and Chemical Ecology**			
Teilnahme-voraussetzungen				
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Lab Course - Physiological and Chemical Ecology: Methods of Chemical Analytics and Transport Physiology (10)	8	300 50 / 50	10
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Poster presentation Protocol to the excercises	Graded (60%) Graded (40%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course Protocol to the excercises	benotet/unbenotet Graded		
Sonstiges	Recommended Reading Domergue F, Kosma D (2017) Occurence and Biosynthesis of Alky Hydroxycinnamates in Plant Lipid Barriers. Plants 6: 25; doi:10.3390/plants6030025 Schreiber L, Franke R, Hartmann K (2005) Wax and suberin development of native and wound periderm of potato (Solanum tuberosum L.) and its relation to peridermal transpiration. Planta 220:520-530 Serra O, Hohn C, Franke R, Prat S, Molinas M, Figueras M (2010) A feruloyl transferase involved in the biosynthesis of suberin and suberin-associated wax is required for maturation and sealing properties of potato periderm. The Plant Journal 62: 277-290			

Transport Physiology				UNIVERSITÄT BONN
Modulnummer **638130290**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **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 M. Sc. OEP Biology	Wahlpflicht	2 or 4

Lernziele	The practical course will provide insights into modern techniques used in molecular plant physiology and ecology. The students should learn different methods in transport physiology and gain experience in planning and performing experiments independently.
Schlüsselkompetenzen	Laboratory techniques in modern plant research. Skills for designing experiments, critical data evaluation, documentation and presentation of scientific results.
Inhalte	In the lab course relevant examples of plant environment interactions from the molecular to the organismic level will be studied. Experiments will deal with water and salt stress, effects of xenobiotics on plants, plant microorganism interaction and secondary plant metabolites. Experimental approaches include measurement of chlorophyll fluorescence, porometry, measurement of cuticular transpiration and uptake of xenobiotics in leaves and analysis of gene expression in response to environmental stimuli. Experiments will be conducted with model and crop species.

TPP	**Transport Physiology**			
Teilnahme-voraussetzungen	Any PBPM module			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Lab Course - Methods of Transportphysiology (10)	8	300 50 / 50	10
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Written exam, 2 hours	Graded		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course Graded, written exam	benotet/unbenotet		
		Graded		
Sonstiges	Summer Term, 3rd time frame (mid June to mid July), this module is also open for the MSc programs Molecular Biology and OEP, suggested literature: 1. Taiz L, Zeiger E (2006) Plant Physiology. Sinauer Associates Inc., Sunderland, MA, 2. Schulze ED, Beck E, and Müller-Hohenstein K. Plant Ecology, Heidelberg: Springer, 2005			

Applied Plant Transcriptomics				UNIVERSITÄT BONN
Modulnummer **638130400**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **WS**
Modulbeauftragter	Prof. Dr. Boas Pucker			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	Prof. Dr. Boas Pucker			
Verwendbarkeit des Moduls	Studiengang		Modus	Studiensemester
	M. Sc. Plant Sciences		Wahlpflicht	1 oder 3
Lernziele	Am Ende des Kurses verfügen die Studierenden über fundierte theoretische und praktische Kenntnisse der transkriptomischen Methoden in der Pflanzenforschung, der Genstrukturen von Pflanzen, der Biologie der Transkription und der Analyse großer Datensätze. Sie sind in der Lage, veröffentlichte Studien zu reproduzieren und deren Ergebnisse kritisch zu interpretieren.			
Schlüsselkompetenzen	Bioinformatics techniques applied to plant transcriptomics research, with a focus on the documentation and presentation of scientific experiments and data.			
Inhalte	The course covers the key steps in analyzing plant RNA-seq data, including quality control, read trimming, de novo transcriptome assembly and evaluation, transcript quantification, statistical analysis of expression data, and visualization of complex results.			

APTO	**Applied Plant Transcriptomics**			
Teilnahme-voraussetzungen	Any PBPM module			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Course - Applied Plant Transcriptomics (12)	8	300 50 / 50	10
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Written exam (30 min)	Graded (100%)		
Studienleistungen	Regular participation in course	benotet/unbenotet		
u.a. als Zulassungs-voraussetzung zur Modulprüfung				
Sonstiges	Recommended Reading Hafner, A.; DeLeo, V.; Deng, C.; Elsik, C.G.; Fleming, D.; Harrison, P.W.; Kalbfleisch, T.S.; Petry, B.; Pucker, B.; Quezada-Rodríguez, E.H.; Tuggle, C.K.; Koltes, J. Data Reuse in Agricultural Genomics Research: Present Challenges and Future Solutions. GigaScience, Volume 14, 2025, giae106, doi: 10.1093/gigascience/giae106. Sielemann, K.*, Hafner, A.* and Pucker B. (2020). The Reuse of Public Datasets in the Life Sciences: Potential Risks and Rewards. PeerJ 8:e9954. doi: 10.7717/peerj.9954. *shared first authorship			

Plant Molecular Cell Physiology and Biotechnology				UNIVERSITÄT BONN
Modulnummer **638130160**	Workload **300h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **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). We will analyze the contents and composition of different lipid molecules in plnats and animals, including tocopherol (vitamin E), fatty acids and sterols.			

MCPB	**Plant Molecular Cell Physiology and Biotechnology**			
Teilnahme-voraussetzungen	Any PBPM module			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Lab Course - Plant Molecular Cell Physiology and Biotechnology (10)	8	300 50 / 50	10
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Oral and/or poster presentation Protocol to the exercises	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 Cellular Signalling				UNIVERSITÄT BONN
Modulnummer **638130140**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **WS**
Modulbeauftragter	Dr. Fatima Chigri			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	Dr. Fatima Chigri Prof. Dr. Ute Vothknecht			

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

Lernziele	Students will be given a solid introduction into plant cellular signaling with emphasis on the role of Ca^{2+} signaling in response to environmental stress. Students will be introduced into the various stimuli that create cellular Ca^{2+} responses as well as the structural and molecular elements involved in the transduction of a stimulus into a dedicated cellular response. The course will demonstrate to the students, how suitable experimental strategies can be developed to address specific scientific questions by choosing, designing and applying the appropriate experimental tools. They will learn how to set-up and perform these experiments by themselves and to interpret the data with regard to the scientific question that was addressed.
Schlüsselkompetenzen	Students learn to set up an experimental design including the necessary time management. They enhance their experimental skills with regard to laboratory techniques in modern plant sciences. They train both their self-reliance and team work abilities as well as skills for documentation and presentation of scientific experiments and data.
Inhalte	The lab course comprises various techniques of molecular biology and biochemistry as well as modern bio-imaging methods. During the course, the students measure free Ca^{2+} content under different stress conditions using transgenic plant lines carrying bio-reporters such as aequorin. The students will learn different methods to analyse protein-protein interaction (pull-down assays, chemical cross-linking…) by analysing the Ca^{2+} dependent interaction between calmodulin and calmodulin-target proteins. Further experimental approaches utilized in the course include recombinant protein expression, isolation of plant organelles, purification of proteins from *E. coli* cultures and plant material as well as Ca^{2+} mobility-shift assays in one- and two-dimensional acrylamid gel systems.

PLCS	**Plant Cellular Signalling**			
Teilnahme-voraussetzungen	none			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Lab Course - Plant Cell Signalling (12)	8	300 50 /50	10
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Performance during laboratory work Oral presentation Protocol to the excercises	Graded (40%) Graded (30%) Graded (30%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course	benotet/unbenotet		
Sonstiges	Recommended Reading Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, and Peter Walter. Molecular biology of the cell. 6th ed. New York:Garland Science, 2015. Bob B. Buchanan, Wilhelm Gruissem, and Russel L. Jones. Biochemistry and Molecular Biology of Plants. 2nd ed. Rockville, MD:American Society of Plant Physiologists, 2015. Shen Luan. Coding and Decoding of Calcium Signals in Plants. Berlin, Heidelberg: Springer Verlag, 2011			

Plant Morphology and Structural Adapation				UNIVERSITÄT BONN
Modulnummer **638130190**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **SS**
Modulbeauftragter	Prof. Dr. Ute Vothknecht			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	Prof. Dr. Ute Vothknecht			
Verwendbarkeit des Moduls	Studiengang		Modus	Studiensemester
	M. Sc. Plant Sciences		Wahlpflicht	1 or 3
Lernziele	Students will be given a solid basis of plant morphology and the adaptation of plant cells, tissues and organs to various functions. They will be introduced into methodologies for plant morphological analysis, especially light microscopy. Based on specific scientific questions of morphological and structural adaptations, students will be guided to develop their own experimental approach including selecting and obtaining the proper plant material.			
Schlüsselkompetenzen	Laboratory techniques in modern cell biology, with a special focus on microscopic techniques and visualization. Skills for documentation and presentation of scientific questions, experimental design and data.			
Inhalte	Within the plant kingdom we find various morphological and cellular variation that are part of structural adaptations to a certain life style or specific climatic conditions. They might also assist in the attraction of pollinators or the defence against pest and herbivors. Difference can occur on a cellular or tissue level as well as by the specific formation of whole organs. This course will look at a number of such structural adaptations both on the organismic and the cellular level.			

<table>
<tr><td>PMSA</td><td colspan="4">Plant Morphology and Structural Adapation</td></tr>
<tr><td>Teilnahme-voraussetzungen</td><td colspan="4">Any obligatory lecture module</td></tr>
<tr><td>Veranstaltungen</td><td>Lehrform, Titel (Teilnehmer)</td><td>SWS</td><td>Workload [h]
% presence /self learning</td><td>LP / ECTS</td></tr>
<tr><td></td><td>Lab Course - Plant Morphology and Structural Adapation (8)</td><td>8</td><td>300
50 / 50</td><td>10</td></tr>
<tr><td rowspan="2">Prüfung(en)
Art, Umfang, Dauer</td><td></td><td colspan="3">benotet/unbenotet</td></tr>
<tr><td>Oral presentation
Protocol to the exercises</td><td colspan="3">Graded (50%)
Graded (50%)</td></tr>
<tr><td>Studienleistungen</td><td rowspan="2">Regular participation in lab course</td><td colspan="3">benotet/unbenotet</td></tr>
<tr><td>u.a. als Zulassungs-voraussetzung zur Modulprüfung</td><td colspan="3"></td></tr>
<tr><td>Sonstiges</td><td colspan="4">Recommended Reading
Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, and Peter Walter. Molecular biology of the cell. 6th ed. New York:Garland Science, 2015.
Russel Jones, Helen Oughma, Howard Thomas and Susan Waaland. The Molecular Life of Plants. West Sussex:Wiley-Blackwell, 2012
Bryan Bowes and James Mauseth. Plant Structure: A Colour Guide. Sudbury:Jones & Bartlett Publishers, 2008</td></tr>
</table>

Plant Gene Expression and Protein Sorting				UNIVERSITÄT BONN
Modulnummer **638130180**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **SS**
Modulbeauftragter	Prof. Dr. Ute Vothknecht			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	Dr. Susann Frank			

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

Lernziele	The aim of the course is to gain deep knowledge about protein sorting in plant cells. The students will work on current questions using different techniques and plant species. Proteins of known and unknown function shall be analyzed concerning the expressions of their genes, the protein amounts and the subcellular localization. After introduction in usage of bioinformatical databases and tools, the students learn to predict bioinformatically the subcellular localization of proteins. Further, the protein localization will be determined by utilizing different cell- and molecular biological methods, for example fluorescence microscopy or cell fractionation.
Schlüsselkompetenzen	Design of cell and molecular biological experiments. Documentation, presentation and discussion of results in a scientific context.
Inhalte	The protein sorting machinery is a complex system in plant cells. Targeting of proteins to subcellular compartments is dependent on different molecular signals such as sequence specific signals, post translational modifications or activation of processing enzymes. For some proteins, the localization can change in respond to environmental factors or the developmental stage. In this course, the situation-dependent subcellular localization of selected proteins will be analyzed. For the selection or limitation of suitable situations, expression analyses of the protein-coding genes will be used.

SORT	**Plant Gene Expression and Protein Sorting**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Lab Course - Plant Gene Expression and Protein Sorting (8)	8	300 50 / 50	10
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Oral presentation Protocol to the excercises	Graded (50%) Graded (50%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course	benotet/unbenotet Ungraded		
Sonstiges	Recommended Reading Buchanan, B. B., Gruissem, W., & Jones, R. L. (Eds.). (2015). Biochemistry and molecular biology of plants. John Wiley & Sons. Special and actual literature.			

Plant Physiology and Cell Biology				UNIVERSITÄT BONN
Modulnummer **638130150**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **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	keine			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Lab Course - Plant Molecular Cell Physiology and Biotechnology 1 (12)	8	300 50 / 50	10
Prüfung(en) Art, Umfang, Dauer		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)			

Mechanistic ecological modelling				UNIVERSITÄT BONN
Modulnummer **638130410**	Workload **150 h**	Umfang **5 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **SS**
Modulbeauftragter	Prof. Dr. J. Sarmento Cabral			
Anbietende Lehreinheit(en)	FG Biologie, BIOB / Section I – Biodiversity of Plants			
Beteiligte Dozenten	Prof. Dr. J. Sarmento Cabral, Dr. V. Bastazini, scientists of the BIOB / Section I			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	2 or 4

Lernziele	1)Mechanistic understanding of ecological systems for defining causal relationships. 2) The use of R for implementing and running these causal relationships (i.e. mechanistic models). 3) Skills for designing, implementing, and communicating mechanistic ecological models.
Schlüsselkompetenzen	
Inhalte	Being able to explicit consider and account for underlying causes is crucial for adequate exploration, hindcasting and forecasting of ecological dynamics, including under natural conditions, deep time dynamics and anthropogenic drivers. This module combines an introduction in programming with R, mechanistic modelling and excercises from the fields of population, community and niche ecology. A special focus will be given to metapopulation dynamics, range dynamics and interaction networks, with and without anthropogenic drivers of the biodiversity crisis. By the end of the module, students should be able to design and implement own mechanistic simulation models in R, as well as to run and interpret simulation experiments.

<table>
<tr><td>MEMO</td><td colspan="4">Mechanistic ecological modelling</td></tr>
<tr><td>Teilnahme-voraussetzungen</td><td colspan="4">OEP-M1, OEP-M2</td></tr>
<tr><td>Veranstaltungen</td><td>Lehrform, Titel (Teilnehmer)</td><td>SWS</td><td>Workload [h]
% presence /self learning</td><td>LP / ECTS</td></tr>
<tr><td></td><td>Lab Course - Mechanistic ecological modelling (12)</td><td>4</td><td>150
60 / 40</td><td>10</td></tr>
<tr><td rowspan="2">Prüfung(en)
Art, Umfang, Dauer</td><td></td><td colspan="3">benotet/unbenotet</td></tr>
<tr><td>Oral presentation, english.
Protocol to the excercises, english</td><td colspan="3">Graded (60%)
Graded (40%)</td></tr>
<tr><td rowspan="2">Studienleistungen
u.a. als Zulassungs-voraussetzung zur Modulprüfung</td><td rowspan="2">Regular participation in lab course</td><td colspan="3">benotet/unbenotet</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>Sonstiges</td><td colspan="4">Recommended Reading
CABRAL et al (2017) Mechanistic models in macroecology and biogeography: state-of-art and prospects. Ecography 40: 267-280. https://doi.org/10.1111/ecog.02480
PRIMACK: Essentials of Conservation Biology.Sinauer.</td></tr>
</table>

Biodiversity and Evolution of Seed-Free Vascular Plants (Ferns a Lycophytes)				UNIVERSITÄT BONN
Modulnummer **638130420**	Workload **150 h**	Umfang **5 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **SS**
Modulbeauftragter	Prof. Dr. Dietmar Quandt			
Anbietende Lehreinheit(en)	FG Biologie, BIOB / Section I – Biodiversity of Plants			
Beteiligte Dozenten	Prof. Dr. Dietmar Quandt, Dr. Jovani Bernardino de Souza Pereira			
Verwendbarkeit des Moduls	Studiengang		Modus	Studiensemester
	M. Sc. Plant Sciences		Wahlpflicht	2 or 4
Lernziele	1) Explain core concepts of systematics, taxonomy, diversity, and morphology of ferns and lycophytes, and analyze how evolutionary processes shape their form and distribution; 2) identify ferns and lycophytes to species level and elaborate basic floristic studies; 3) analyze character evolution across major fern and lycophyte lineages and interpreting patterns in morphology, physiology, and ecology; 4) recognize hybrids and evaluate their ecological and evolutionary significance; 5) describe and compare alternation of generations and their ecological implications.			
Schlüsselkompetenzen				
Inhalte	This course provides an overview on fundamental aspect of the evolution, taxonomy, systematics, biology, and geographic distribution of ferns and lycophytes. It combines day excursions to assess regional diversity with hands-on examination of specimens in botanical gardens. Students learn the diagnostic morphological characters of the major groups and how these relate to natural phylogenetic classification, while exploring how morphology, physiology, and ecology shaped these systems. During the course, they will familiarize themselves with terminology for species-level identification, enabling them to carry out a floristic study, alongside field-based investigations of ecological and morphological traits in natural habitats. They will gain a deeper understanding of the life cycles of these plants and learn to distinguish hybrids from their putative parents.			

SBLF/OEP-B33	**Systematic and Biology of Lycophytes and Ferns**			
Teilnahme-voraussetzungen	OEP-M1, OEP-M2			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Lab Course incl. Excursions - Systematic and Biology of Lycophytes and Ferns (12)	4	150 60 / 40	5
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Oral presentation, english Protocol to the excercises, english	Graded (60%) Graded (40%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course	benotet/unbenotet		
Sonstiges	Recommended Reading Ranker and Haufler (2008) Biology and evolution of ferns and lycophytes, Cambrigde University Press. PPGI (2016) A community-derived classification for extant lycophytes and ferns Journal of Systematics and Evolution 54: 563-603.			

Python for Life Scientist				UNIVERSITÄT BONN
Modulnummer **638130390**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **SS**
Modulbeauftragter	Prof. Dr. Boas Pucker			
Anbietende Lehreinheit(en)	FG Biologie, IZMB			
Beteiligte Dozenten	Prof. Dr. Boas Pucker			

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

Lernziele	Participants will become familiar with the key functionalities of Python, including various variable types and control structures. Upon completion of this module, students will be able to plan a programming project to address a biological question, write scripts to analyze datasets, document and store the developed scripts, use artificial intelligence to generate code, and document their solutions.
Schlüsselkompetenzen	Ability to break down complex biological problems and solve them by writing Python code.
Inhalte	The seminar provides an introduction to Python. File processing with Python will be covered, along with specific (bioinformatics) modules including *matplotlib*, *numpy*, *scipy*, *dendropy*, and *pandas*. Students will learn how to plan, execute, document, and organize programming projects. They will complete basic tasks to become familiar with writing Python code. Common data-related challenges in the life sciences will be addressed. Students will also learn how to use AI to effectively generate code. Finally, they will be given a biological question to solve independently—from initial planning through to presentation and documentation.

PFLS	**Python for Life Scientists**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Course - Python for Life Scientists (12)	8	300 55 / 45	10
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Protocol	Graded (100%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course Presentation	benotet/unbenotet		
Sonstiges				

Vegetation Ecology				UNIVERSITÄT BONN
Modulnummer **638130370**	Workload **150/300 h**	Umfang **5/10 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **SS / WS**
Modulbeauftragter	Prof. Dr. Dietmar Quandt, Prof. Dr. Maximilian Weigend			
Anbietende Lehreinheit(en)	FG Biologie, BIOB, Abt. 1			
Beteiligte Dozenten	Dr. Cornelia Löhne,, Dr. Jens Mutke, Prof. Dr. Dietmar Quandt, Prof. Dr. Maximilian Weigend, NN			

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 3 weeks) or several small field trips.

PBEC	**Vegetation Ecology**			
Teilnahme-voraussetzungen	Lecture OB1 Systematics and Biodiversity or sound botanical background from BSc studies			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Lab Course - Vegetation Ecology (incl. fieldw. & excurs.) (15, Minimum 7 participants)	4/8	150/300 50 / 50	5/10
Prüfung(en) Art, Umfang, Dauer		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 LOMOLINO, RIDDLE, WHITTAKER & BROWN. Biogeography, Sinauer. MILLINGTON, BLUMLER & SCHICKHOFF (eds.). Handbook of Biogeography. Sage Publications: London FREY & LÖSCH : Lehrbuch der Geobotanik. Elsevier, Spektrum Verlag. SCHULZE, BECK & MÜLLER-HOHENSTEIN: Plant Ecology. Springer. 702 pp WALTER & BRECKLE: Vegetationszonen und Klima. UTB, Ulmer, Stuttgart			

Palaeobotany and Palynology				UNIVERSITÄT BONN
Modulnummer **638130210**	Workload **150 h**	Umfang **5 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **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, 4
	M. Sc. OEP Biology	Wahlpflicht	2, 4

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 Microscope (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] % presence /self learning	LP / ECTS
	Lecture - Palaeobotany and terrestrial palaeoecology (50) Lab Course - Palaeobotany and Palynology (15)	1 3	30 120 50 /50	1 4
Prüfung(en) Art, Umfang, Dauer		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			

Genome Analysis in Plant Breeding				UNIVERSITÄT BONN
Modulnummer **638130220**	Workload **180 h**	Umfang **6 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **WS**
Modulbeauftragter	Prof. Dr. A. Mason			
Anbietende Lehreinheit(en)	INRES, Pflanzenzüchtung			
Beteiligte Dozenten	Prof. Dr. A. Mason, N.N.			

Verwendbarkeit des Moduls	Studiengang	Modus	Studiensemester
	M. Sc. Plant Sciences	Wahlpflicht	1 or 3
	M. Sc. Nutzpflanzenwissenschaften	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	Independent literature review, Lab work, Team work
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 classical 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 segregating population. Applications of DNA markers in plant breeding are numerous. During the course of the lecture following topics will be presented: (1) the genome analysis using DNA markers and next generation sequencing techniques, (2) the generation of linkage maps, (3) the detection and selection of favorable genes for monogenic and polygenic, i.e. quantitative traits; single gene and QTL mapping, (4) the marker-assisted selection of favorable genotypes, (5) the identification and differentiation of varieties and (6) the isolation and utilization of new genes in plant breeding, e.g for pathogen resistance. During the practical course the relevant methods will be introduced.

GAPB	**Genome Analysis in Plant Breeding**			
Teilnahme-voraussetzungen	None			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Lecture - Genome Analysis in Plant Breeding (30) Lab Course - Genome Analysis in Plant Breeding (12)	2 2	120 60 55 / 45	4 2
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Written exam	Graded		
Studienleistungen	Successful participation in the practical course	benotet/unbenotet		
u.a. als Zulassungs-voraussetzung zur Modulprüfung		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 Redox Homeostasis and Signalling				UNIVERSITÄT BONN
Modulnummer **PRHS**	Workload **300 h**	Umfang **10 CP**	Dauer Modul **1 Semester**	Turnus / Häufigkeit **WS**
Modulbeauftragter	Prof. Dr. Andreas Meyer			
Anbietende Lehreinheit(en)	INRES – Chemical Signalling			
Beteiligte Dozenten	Prof. Dr. A. Meyer, N.N.			
Verwendbarkeit des Moduls	Studiengang		Modus	Studiensemester
	M. Sc. Plant Sciences M. Sc. Nutzpflanzenwissensschaften		Wahlpflicht	3
Lernziele	Students will obtain a solid understanding of thiol-redox biochemistry and mechanisms of maintaining redox homeostasis. In addition students will gain hands-on experience in molecular biology and live cell imaging.			
Schlüsselkompetenzen	Project planning and management; lab work and organisation; scientific writing; communication and oral presentation of results; critical reading.			
Inhalte	Participants in this 6-week lab course will select specific projects that are closely related to ongoing research projects in the host lab. For a plant to grow and develop regulation of its cellular functions is critical. Changes in the evironment require flexible control of cellular metabolism, physiology and subcellular organisation in response. Molecular switches can provide this level of regulation, but their specific identities and roles are mostly not resolved. One important class of such regulatory switches are protein thiol switches which are responsive to changes in the degree of oxidation. Molecular understanding of such thiol switches and their impact in cellular physiology is a prerequisite for defining traits such as yield or stress resistance. The function of thiol switches in redox-dependent signalling pathways may also link into and impact on other signalling cascades like *e.g.* Ca^{2+}-dependent signalling, and into regulation of energy handling by the plant. The course will introduce state-of-the-art technologies and experimental approaches for functional analysis of thiol switches and their respective molecular operators. Depending on the exact project this includes isolation of genetic mutant plant lines and their characterization at physiological and molecular level. Experimental approaches to be taught include modern molecular biology techniques, biochemical protein analysis and advanced optical microscopy-based imaging and sensing methods.			

PRHS	**Plant Redox Homeostasis and Signalling**			
Teilnahme-voraussetzungen	Any PBPM LAB module			
Veranstaltungen	Lehrform, Titel (Teilnehmer)	SWS	Workload [h] % presence /self learning	LP / ECTS
	Lab Course - Plant Redox Homeostasis and Signalling (2)	8	300 50 / 50	10
Prüfung(en) Art, Umfang, Dauer		benotet/unbenotet		
	Oral presentation Written report	Graded (30%) Graded (70%)		
Studienleistungen u.a. als Zulassungs-voraussetzung zur Modulprüfung	Regular participation in lab course	benotet/unbenotet		
Sonstiges	Recommended Reading Bob B. Buchanan, Wilhelm Gruissem, and Russell L. Jones (eds.). Biochemistry & Molecular Biology of Plants, Chichester, John Wiley & Sons Ltd, 2015. Project-specific papers will be suggested after definition of a project.			

Colloquium Reports in the Plant Sciences				UNIVERSITÄT BONN
Modulnummer **CRPS**	Workload **240 h**	Umfang **5 CP**	Dauer Modul **1 - 3 Semester**	Turnus / Häufigkeit **SS/WS**
Modulbeauftragter	Prof. Dr. Peter Dörmann*, PD Dr. Rochus Franke, AOR Dr. Jens Mutke, Prof. Dr. Ute Vothknecht (and other regular lecturers in the program upon appointment)			
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) to appreciate different styles of presentation and adapt, learn and improve their own styles of presentation c) to formulate questions or contributions for subsequent discussions and d) to 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 (see below) by the inviting scientist at the respective host institute.

<table>
<tr><td>CRPS</td><td colspan="4">Colloquium Reports in the Plant Sciences</td></tr>
<tr><td>Teilnahme-voraussetzungen</td><td colspan="4">None.</td></tr>
<tr><td>Veranstaltungen</td><td>Lehrform, Titel (Teilnehmer)</td><td>SWS</td><td>Workload [h]
% presence /self learning</td><td>LP / ECTS</td></tr>
<tr><td></td><td>Visiting a minimum of 8 invited scientific presentations in the Botanical Colloquium</td><td>-</td><td>150
15 / 85</td><td>5</td></tr>
<tr><td rowspan="2">Prüfung(en)
Art, Umfang, Dauer</td><td></td><td colspan="3">benotet/unbenotet</td></tr>
<tr><td>Regular participation (min 8 time) in the Botanical Kolloquium
3-5 pages report on a selected Kolloquium lecture See below. Reports will be inspected and graded by academic staff members who hosted the reported lecture.
No further examination.</td><td colspan="3">Not graded

Graded</td></tr>
<tr><td rowspan="2">Studienleistungen
u. a. als Zulassungs-voraussetzung zur Modulprüfung</td><td rowspan="2">Regular participation (min 8 time) in the Botanical Kolloquium</td><td colspan="3">benotet/unbenotet</td></tr>
<tr><td colspan="3">Not graded</td></tr>
<tr><td>Sonstiges</td><td colspan="4">Student’s report cards will be handed out by the module coordinators upon registration of a student for CRPS. Talk to be summarized with the 3-5 pages report may be freely selected by the students from presentations attended during their 1st through 3rd term. Written reports need to be submitted for evaluation by the end of the 3rd term of the course program.</td></tr>
</table>