



Modulhandbuch

Master of Science

Immunobiology: from molecules to integrative systems

Modul: Methods in life sci	ences and st	atistics		UNI\	/ERSITÄ	TBONN			
Module Number	Workload	СР	Duration		cycl	 e			
LIMES-001	90	3 1 Semester annual							
Representative	Prof. Dr. Chri	stoph Thiel	e, Prof. Dr. Matt	hias Schm	id				
Providing institution	LIMES-Institute Institute of Medical Biometry, Medical Informatics, and Epider								
		Study coul	rse	Catego	ry S	Semester			
	Biochemistry Immunobiologi integrative sy Medical Immu (MSc)	gy: from mo stems (MS	P	1.					
Learning objective	Students sho and methodo Additionally, and correct in	Students should learn theoretical background of common techniques and methodological approaches from the area of life sciences. Additionally, students will gain an understanding of hypothesis testing and correct interpretation of different types of test statistics. They will improve their skills in statistical calculations and adequate planning of							
Skills	Profound knowledge on methodology in life sciences Being able to perform statistical analysis of obtained results								
Content	blotting, RT-F lipids, immun microscopy Statistics: Ba Non-paramet	Dealing with DNA, RNA, proteins and lipids, electrophoresis, western blotting, RT-PCR, protein purification, cloning technologies, analysis of lipids, immunoprecipitation, histology, ELISA, Flow cytometry, FRET, microscopy Statistics: Basic test theory, Chi²-tests for contingency tables, t-tests, Non-parametric tests, Power calculations, Calculation rules for probabilities, Correlation, Regression, Software implementations,							
Requirements	none								
Courses	Kind	S	Subject	Group size	SWS	Workload [h]			
	Lecture	Methods sciences	in Life and statistics	85	2	90			
Examinations		Prüfung	sform(en)		gradeo	d/ungraded			
	Written exam				Graded				
Requirements for admission to exam		_			gradeo	d/ungraded			
Miscellaneous									

Modul: Methods course I				UNIVE	RSITÄT	BONN		
Module Number	Workload	CP	Duration		cycle			
LIMES-002	450	15	1 Semester		annu	al		
Representative	Prof. Dr. Gü	Prof. Dr. Günter Mayer						
Providing institution	LIMES-Insti	tute						
		Study cour	se	Category	y S	Semester		
		y (MSc) ogy: from mo systems (MSc		P	1.			
Learning objective		ological expe	plan and conduc eriments either or					
Skills	the principle references a content of p methods in	By the end of the course, students should know and be able to apply the principles of planning and performing an experiment, searching for references and literature, reading, understanding and discussing the content of primary research papers. They should understand the methods in biochemical research.						
Content	from tissues	Cloning of DNA, isolation of lipids, proteins, metabolites, DNA or RNA from tissues, purification of recombinant proteins, enzyme activity assays, plasmid transfection, theory and practice on buffer generation						
Requirements	none							
Courses	Kind	S	ubject	Group size	SWS	Workload [h]		
	Practical course	Methods i sciences	n Life	65	10	450		
Examinations		Prüfungs	sform(en)		graded	l/ungraded		
	Written exar	n			Grad	ed (50%)		
	Protocol	Grad	ed (50%)					
Requirements for	Records of	conducted ex	periments			l/ungraded		
admission to exam					un	graded		
Miscellaneous								

Module: Immunology I					11010/6	-DCIT		
Module Number	Workload	СР	Duratio		UNIVE		T BONN	
Immuno-001	180h	6	1 Semes			cyc annı		
Person in charge of the module	Prof. Sven B	Prof. Sven Burgdorf, Prof. Eicke Latz						
Teaching Unit offering the module		IMES-Institute nstitute of Innate Immunity						
onering the module	Study Progra		iity	М	ode	Study	Semester	
Applicability of the module	Immunobiolo integrative sy Medical Imm (M.Sc.)	stems (MS		P n		1.		
Learning Outcomes	differentiated immune syst an immune r systems and have acquire based on the	At the end of this module the students have acquired detailed and differentiated knowledge the cellular and humoral components of the mmune system and the necessary and sufficient conditions to mount an immune response. Furthermore, they can describe current model systems and techniques used to study the immune system. Students have acquired advanced conceptual and methodological thinking skills based on the discussion of current scientific literature in immunology.						
Key competences	Know the key Being able to	Understanding the principles of the immune system Know the key methods and their applications Being able to read, understand and present fundamental issues in innate immunity						
Contents	Cellular and model organi peptides, efformolecular pa (DAMPs), Pa and in the cy	Evolution of the immune system from bacteria to higher vertebrates. Cellular and humoral components of the immune system, different model organisms, basic principles of immune responses, anti-microbial peptides, effector functions of immune cells, Pattern-associated molecular patterns (PAMPs), Damage-associated molecular patterns (DAMPs), Pattern recognition receptors (PRRs) at the cell membrane and in the cytoplasm, signaling pathways of PRRs and other receptor's signaling pathways, inflammasomes, complement system.						
Prerequisites for participation	None							
p an are p and a	Teaching mode	Topic		Grou size	ıp-	sws	Workload [h]	
Course elements	Lecture	Biology of responses		45		2	90	
	Tutorial					1	45	
	Seminar					1	45	
Examination(s)	Type of exar	. ,				Graded graded	/ non-	
	Written exam	nination				graded		
Study elements required as			ar, oral presein accompanyir			Graded graded	/ non-	
prerequisite for admission to the module examination	handout	milai willi di	. accompanyii	ig WI		Non-gra	aded	
Additional Information	Recommend	ed Reading	:		,			
			gy; Kenneth M ay; New York:					

Roitt's Essential Immunology; Peter J. Delves, Seamus J. Martin,
Dennis R. Burton, Ivan M. Roitt; Wiley-Blackwell 12 th Edition 2011

Modul: Introduction in exp and bioethics	perimental a	nimal techr	niques	UNIV	ŒRSITÄT	BONN		
Module Number LIMES-003	Workload 90	CP 3	Duration 1 Semester	,	cycle annu			
Representative	1	Prof. Dr. Irmgard Förster						
Providing institution	LIMES-Instit							
	Biochemistry Immunobiolo integrative sy	gy: from mo	lecules to	P Categor	ry S	emester		
Learning objective	models and	be acquainte animal expe	comprehensive d with the releverimentation, as	ant legal a	nd bioeth	ical		
Skills	models and knowledge of targeting tec	Understanding the advantages and disadvantages of different animal models and their possible application in biomedical research; knowledge of the methodology of animal experimentation and gene targeting techniques; ability to observe animal protection laws and to apply 3R strategies						
Content	breeding req background studies of de behavior; an (homologous CRISPR-Cas	uirements ar and environn velopment, r esthesia and recombinati s technology animals; bio	nal models (dros nd animal welfa nental influence metabolism, imi analgesia; ger on in embryoni); German/Euro ethics and the	re; importa es (nutrition munology, ne targeting c stem cell pean legis	nce of ge ; microbiolo neurobiolo techniqu s; TALEN lation for	netic ota); in vivo ogy and es and the		
Requirements	none	1 0.	.laia at	0	CMC)		
Courses	Kind	50	ubject	Group size	SWS	Workload [h]		
	Lecture	Experimer and statist	ital animals	65	2	90		
Examinations		Prüfungs	form(en)			l/ungraded		
	Written exan	า			G	raded		
Requirements for admission to exam	none				graded	l/ungraded		
Miscellaneous								

Module: Immunology II									
Madula Numbar	Modelood	Cytont	Duratio		UNIV		BONN		
Module Number MedImmun-04	Workload 180h	Extent 6 LP	Duratio 1 Semes			Cycl Annu			
Person in charge of the module	Prof. Dr. Irmgard Förster, Prof. Christian Kurts								
Teaching Unit offering the module		nstitute of Experimental Immunology _IMES-Institute							
Applicability of the	Study Progra	am			Mode	Study	Semester		
module	(M.Sc.) Immunobiolo	ogy: from mo		n I	P	2.			
Learning Outcomes	At the end of knowledge of differentiation genetic pred Students can mediated crosstudents are and have ac	At the end of this module students have acquired comprehensive knowledge of molecular mechanisms of lymphocyte development and differentiation, and in immunogenetics, covering epigenetic patterns, genetic predisposition, gene rearrangement and polymorphisms. Students can explain cell-cell interactions, chemokine and cytokine mediated cross-talk. Students are familiar with the relevant methodology applied in the field and have acquired advanced conceptual and methodological thinking skills based on the discussion of current scientific literature in							
Key competences	Know the ke Being able to	Understanding the principles of the immune system Know the key methods and their applications Being able to read, understand and present fundamental issues in innate immunity							
Contents	organization mechanism switch and s B cell subset lymphocyte	B cell development, T cell development and thymic selection; organization of the Immunoglobulin and T cell receptor locus; mechanism of somatic gene rearrangement, immunoglobulin class switch and somatic hypermutation; BCR and TCR signal transduction; B cell subsets, T helper cell subsets, regulatory T and B cells; lymphocyte migration; intercellular communication; tolerance mechanisms, immunological memory; epigenetic patterns, genetic							
Prerequisites for participation	None	7 0			,				
	Teaching mode	Topic		Gro size		sws	Workload [h]		
Course elements	Lecture	Advanced in immuno	•	45		2	90		
	Seminar		9 ,			1	45		
	Tutorial					1	45		
Examination(s)	Type of exar	mination(s)				Graded/ graded	non-		
Examination(3)	Written exan	nination				graded			
Study elements required as prerequisite for admission to the module examination	one seminar with an accompanying written grad					Graded/ graded Non-gra			
Miscellaneous									

Modul: Methods course II	Methods course II							
Module Number	Workload	СР	Duration		cycl	е		
LIMES-004	450							
Representative	Prof. Dr. Gü	Prof. Dr. Günter Mayer						
Providing institution	LIMES-Instit	tute						
		Study cour	se	Category	ry Semester			
		y (MSc) ogy: from mo ystems (MSc		Р	1.			
Learning objective	Students she molecular bi	ould learn to ological expe	plan and conductoriments either of					
Skills	By the end of the principle references a content of pr	By the end of the course, students should know and be able to apply the principles of planning and performing an experiment, searching for references and literature, reading, understanding and discussing the content of primary research papers. They should understand the methods in biochemical research.						
Content			life sciences incl ples of fluorescer					
Requirements	none							
Courses	Kind	S	ubject	Group size	SWS	Workload [h]		
	Practical course	Methods i sciences	n Life	65	4	180		
Examinations		Prüfungs	sform(en)		gradeo	l/ungraded		
	Written exar	n	, ,		Grad	ed (50%)		
	Protocol Graded (5							
Requirements for	Records of o	conducted ex	periments		gradeo	l/ungraded		
admission to exam					un	graded		
Miscellaneous								

Modul: Biochemistry and	Organic Che	mistry		UNIV	/ERSITÄ	BONN			
Module Number	Workload	СР	Duration		cycl	е			
Biochem-003	90	3	1 Semeste	r	annu				
Representative	Prof. Dr. Chr	istoph Thie	le and Prof. Dr.	Michael Fa	mulok				
Providing institution	LIMES-Instit	ute							
		Study cou	Catego	,	Semester				
	Biochemistry Immunobiolo integrative sy	gy: from mo		WP	1.				
Learning objective	biochemistry relevance for	and the ke understand	ne basic structur y organic reaction ding how some ular enzymatic i	ons and rea biochemica	ction me				
Skills	Knowledge p Knowledge of Understandir activation of Being able to	chemical basis, in particular enzymatic reactions. Basic knowledge of biochemical pathways Knowledge protein structure and function Knowledge of basic regulatory elements to regulate enzyme activity Understanding the key principles of Organic Chemistry, particularly activation of chemical bonds and reaction mechanisms. Being able to read and understand and present fundamental issues in							
Content	Michaelis-Me gluconeogen pathway, gly amino acid s oxidation) Key principle relevance for mechanisms bond breaka	Basic protein structure and folding, DNA structure and replication, Michaelis-Menten-type kinetics, basic metabolic pathways (Glycolysis, gluconeogenesis, TCA cycle, glyoxalate cycle, pentose phosphate pathway, glycogen metabolism, respiratory chain and ATP synthase, amino acid synthesis and degradation, fatty acid synthesis and beta- oxidation) Key principles of organic reaction mechanisms, key organic reactions of relevance for biological systems with an emphasis on enzymatic mechanisms, basic principles of activation / deactivation of chemical bond breakage and formation, basic principles of some synthetic procedures with emphasis on biological molecules such as DNA, RNA,							
Requirements	none								
Courses	Kind Lecture	Biochemi	Subject stry and	Group size 65	SWS 2	Workload [h] 90			
		organic c	<u>-</u>						
Examinations						d/ungraded graded			
Requirements for admission to exam Miscellaneous	None				graded	d/ungraded			

Modul: Cellbiology and Im	nmunology			UNIVER	SITÄT	BONN		
Module Number	Workload	СР		cycle	 9			
Immuno-002	90	3	1 Semester		annu			
Representative	Prof. Dr. Sve	Prof. Dr. Sven Burgdorf and PD Dr. Marc Beyer						
Providing institution	LIMES-Instit	tute						
		Study cour	se	Category		emester		
	integrative s	ogy: from mo ystems (MSc	WP	1.				
Learning objective		Students should apply fundamental knowledge on basic cell-biological and immunological topics on a cellular and molecular level						
Skills	Understandi	Understanding the key principles in cell biology and immunology						
Content	membranes, translational proteins, sig endocytosis,	nucleic acid trafficking of naling mecha energy met	cell, cellular comples, protein synthe foroteins, post-transms and seconabolism in mitchcem, basic principles.	sis and degranslational rend messengendria, extra	radation modifica ers, cy cellular	n, post- ations of toskeleton, matrix,		
Requirements	none							
Courses	Kind	S	ubject	Group size	SWS	Workload [h]		
	Lecture	Cell Biolog		65	2	90		
Examinations		Prüfungs	sform(en)		graded	l/ungraded		
	Written exam ungraded					graded		
Requirements for admission to exam	None				graded	I/ungraded		
Miscellaneous								

Modul: Genetics and Mole	ecular Biolog	ју		UNIV	'ERSITÄ	BONN		
Module Number	Workload	CP	Duration		cycle			
Immuno-003	90	3	1 Semester		annu	al		
Representative	Prof. Dr. Mic	Prof. Dr. Michael Pankratz and PD Dr. Reinhard Bauer						
Providing institution	LIMES-Instit	LIMES-Institute						
		Study cour	se	Catego	ry S	Semester		
	Biochemistry Immunobiolo integrative s	gy: from mo		WP	1.			
Learning objective		-	oncepts of the ir regulation and					
Skills	combining th	Understanding the principles of molecular biology and genetics, and combining this knowledge with biology, biochemistry, advanced genetics (genetic engineering) and genomics/bioinformatics						
Content	structure and replication a and monitori through qual transduction	Organization of eukaryotic cells and their dynamic functions. Molecular structure and function of DNA and RNA and the mechanisms of replication and transcription. Design and cloning of expression vectors and monitoring gene expression experimentally in whole animals and through quantitative PCR. Description of major mechanisms of signal transduction and how to study such mechanisms by using transgenic animals and forward and reverse genetic methods.						
Requirements	none							
Courses	Kind	S	ubject	Group size	SWS	Workload [h]		
	Lecture	Genetics Molecular		65	2	90		
Examinations		Prüfungs	sform(en)		gradeo	d/ungraded		
						graded		
Requirements for admission to exam	None				gradeo	d/ungraded		
Miscellaneous								

Modul: Inorganic Chemist	ry and Physi	ical Chemi	stry					
				UNIV	'ERSITÄ	BONN		
Module Number	Workload	СР	Duration		cycl	е		
Biochem-004	90	3	1 Semester		annu	al		
Representative	Prof. Dr. Tho	Prof. Dr. Thorsten Lang						
Providing institution	LIMES-Institu	ute						
		Study cour	se	Catego	Category Semester			
	Immunobiolo	Biochemistry (MSc) Immunobiology: from molecules to integrative systems (MSc)						
Learning objective	Students sho	Students should obtain basic knowledge of inorganic chemistry and physical chemistry						
Skills		Being capable of understanding fundamental mechanisms on the level of single atoms or small molecules.						
Content	acids and ba Physical che	Inorganic chemistry: salts, ions, hydration, coordination chemistry, acids and bases, inorganic reactions, solubility product Physical chemistry: thermodynamics (kinetic gas theory, enthalpy, entropy, free enthalpy) and kinetics (reaction order, transition states, catalysis)						
Requirements	none					_		
Courses	Kind	S	ubject	Group size	SWS	Workload [h]		
	Lecture	Inorganic Chemistry	and Physical	65	2	90		
Examinations		Prüfungs	form(en)		gradeo	d/ungraded		
	Written exam ungraded					graded		
Requirements for admission to exam	None				gradeo	d/ungraded		
Miscellaneous								

Modul: Insights in the wor	kflow of life s	science co	ompanies 1	UNIV	ERSITÄT	BONN		
Module Number	Workload	CP	Duration		cycl	е		
LIMES-005	90	3	1 Semester		annu	al		
Representative	Prof. Dr. Joac	Prof. Dr. Joachim Schultze						
Providing institution	LIMES-Institu	te		_				
		Study cour	se	Category		Semester		
	Biochemistry Immunobiolog integrative sy	y: from mo		WP	2.			
Learning objective	procedures, of scientists with immunology of	organization n a master's or related lif	ghts into basic wo al structures and or PhD degree e science degree focusing on imm	employme in molecula es in genera	ent oppo or and sy al and pa	rtunities for estems articular in		
Skills	opportunities and systems other areas w foundations, i Get firsthand	Being able to understand, classify and judge the employment opportunities for scientists with a master's or PhD degree in molecular and systems immunology or related life science degrees in industry or other areas within the private sector (e.g. funding agencies, foundations, non-profit organizations, etc.) Get firsthand knowledge about employment opportunities and start networking with colleagues within the private sector.						
Content	within the privoperate, how An emphasis organizations Students will	networking with colleagues within the private sector Students will get the opportunity to visit two selected organizations within the private sector to get insights into how these organizations operate, how they are organized, and what the working conditions are. An emphasis will be research and development within these organizations. Students will also learn to organize such visits autonomously. Concerning the format of the visits students will be granted sufficient						
Requirements	none							
Courses	Kind	- ;	Subject	Group	SWS	Workload		
	2 Excursions		in companies tutions from life	size 22	1	[h] 90		
Examinations					gradeo	l/ungraded		
Laminations	Prüfungsform(en) graded/ungrade None Ungraded							
Requirements for	None				gradeo	d/ungraded		
admission to exam	140110			-	gradec	a, arigidada		
Miscellaneous								

Modul: Insights in the wo	rkflow of life	science c	ompanies 2	UNIV	'ERSITÄ ⁻	BONN				
Module Number LIMES-006	Workload 90	CP 3	Duration 1 Semeste	r	cycle annual					
Representative	Prof. Dr. Joac	Prof. Dr. Joachim Schultze								
Providing institution	LIMES-Institute									
<u> </u>		Study cour	se	Catego	ry S	emester				
	Biochemistry Immunobiologintegrative sy	gy: from mo		WP	2.					
Learning objective	procedures, of scientists with immunology respect to orgor services. I science produces	Students should get insights into basic work routines, operational procedures, organizational structures and employment opportunities for scientists with a master's or PhD degree in molecular and systems immunology or related life science degrees in general and particular in respect to organizations focusing on immune system-related products or services. They will learn about research and development of life science products and services in industry directly from representatives of selected companies that agreed to present themselves within the								
Skills	Being able to understand, classify and judge the employment opportunities for scientists with a master's or PhD degree in molecular and systems immunology or related life science degrees in industry or other areas within the private sector (e.g. funding agencies, foundations, non-profit organizations, etc.) Understanding the principles of research and development in the life science sector with an emphasis on 'red' biotechnology, pharma, medical engineering, and the life science software industry sectors. Know the key research and development approaches and their applications within these companies.									
Content	Students will get the opportunity to visit one selected organization within the private sector to get insights into how these organizations operate, how they are organized, and what the working conditions are. An emphasis will be research and development within these organizations. Additionally, they will attend one interactive workshop with company representatives from research and development, strategic management, marketing or sales, students will get to know the basic aspects of products, services and the research and development leading to these products Students will also get the opportunity to discuss issues concerning industrial research and development, products, services and sales with									
Requirements	none									
Courses	Kind	S	ubject	Group size	SWS	Workload [h]				
	1 Excursion 1 Seminar	and institution in the science workflow	in companies utions from	22	1	45 45				

Examinations	Prüfungsform(en)	graded/ungraded
	None	Ungraded
Requirements for admission to exam	None	graded/ungraded
Miscellaneous		·

Modul: Insights in the wor	kflow of life	science c	ompanies 3	UNIV	-RSITÄT	BONN		
Module Number	Workload	CP	Duration	tion Cycle				
LIMES-007	90	, , , , , , , , , , , , , , , , , , , ,						
Representative		Prof. Dr. Joachim Schultze						
Providing institution	LIMES-Institu	ıte						
		Study coul	se	Catego	y S	emester		
	Biochemistry Immunobiologintegrative sy	gỳ: from mo		WP	2.			
Learning objective	Students will products and	Students will learn about research and development of life science products and services in industry directly from representatives of selected companies that agreed to present themselves within the						
Skills	Understanding the principles of research and development in the life science sector with an emphasis on 'red' biotechnology, pharma, medical engineering, and the life science software industry sectors. Know the key research and development approaches and their applications within these companies. Being able to read, understand and present fundamental issues in the area of research and development of the respective company.							
Content	representative management aspects of preleading to the Students will industrial research.	es from res, marketing oducts, serese product also get the earch and c	interactive work earch and deve or sales, studer vices and the rese opportunity to development, prospective compa	lopment, st nts will get search and discuss iss oducts, serv	rategic to know to developous ues conc vices and	ne basic ment erning sales with		
Requirements	none	1				T		
Courses	Kind		ubject	Group size	SWS	Workload [h]		
	2 Seminars		in companies utions from ces	22	1	90		
Examinations		Prüfung	sform(en)		graded	/ungraded		
	None Ungraded							
Requirements for	None				graded	l/ungraded		
admission to exam					J : = 3 C			
Miscellaneous								

Modul: Labrotation 1: Ir	mmunology			UNI	VER!	SITÄT	BONN			
Module Number	Workload	CP	Duration		Cycle					
Immuno-005	360 h	Eve	Every semester							
Representative	Prof. Dr. Sven I	Prof. Dr. Sven Burgdorf								
Institution	LIMES-Institute									
		Study Course	е	Catego	ory	S	emester			
	Immunobiology integrative syst	ems (MSc)		WP		2.				
Learning Objective	joining ongoing the LIMES Insti specific immund be presented in including an info presentation of	Students should acquire hands-on experience in scientific research by oining ongoing research projects in the working groups of Immunology at the LIMES Institute. They should be able to design, conduct and evaluate specific immunological or cell biological experiments. The project should be presented in a written report in analogy to a scientific publication, including an informative introduction, comprehensive and logical presentation of the data, as well as a critical discussion and interpretation of the results in light of the relevant literature.								
Skills	Experimental skills in state-of-the-art immunological and cell biological techniques; ability to design scientific experiments and to critically evaluate scientific data; Soft skills in written and oral presentation of scientific results; ability to work in a team.						ly evaluate ntific			
Content	The scientific to of the supervisor guaranteed.	•		•			ntific scope			
Requirements										
Courses	Kind	su	bject	group size	S'	WS	Workload [h]			
	Laboratory course	Immunolo	gy	1		8	360			
Examinations		•		1	G	raded	/Ungraded			
	 Publication-like written summary of results obtained, data interpretation and discussion Lab course Graded (40%) Graded (60%) 									
Requirements for					G	<u>rad</u> ed	/Ungraded			
admission to	Lab journal						graded			
exam	regular participa Data presentati		up seminar			-	graded graded			
Miscellaneous					•					

Modul: Labrotation 1: G Immunology	Senomics, Epig	enetics an	d Systems		UNIVEF	RSITÄT	BONN			
Module Number	Workload	СР	Duratio	n		Cycl	e			
Immuno-006	360 h	12	(weeks		Every semester					
Representative	Prof. Dr. Sven B	Burgdorf								
Institution	LIMES-Institute									
		Study Course			Category		emester			
	Immunobiology: integrative syste	ems (MSc)			/P	2.				
Learning Objective	joining ongoing epigenetics and be able to design should be presepublication, inclingical presentations.	Students should acquire hands-on experience in scientific research by oining ongoing research projects in the working groups of genomics, epigenetics and systems immunology at the LIMES Institute. They should be able to design, conduct and evaluate specific scientific. The project should be presented in a written report in analogy to a scientific publication, including an informative introduction, comprehensive and ogical presentation of the data, as well as a critical discussion and interpretation of the results in light of the relevant literature.								
Skills	Planning and implementation of a scientific project, ability to design scientific experiments and to critically evaluate scientific data; Hand-contexperience in state-of-the-art methodology, Collecting and interpretation project-relevant literature, Soft skills in written and oral presentation scientific results; ability to work in a team.						ta; Hand-on rpretation of			
Content	The scientific to of the supervisor guaranteed.	•		-			tific scope			
Requirements										
Courses	Kind	su	bject	group	size S	SWS	Workload [h]			
	Laboratory course	Genomics Epigenetic Systems I			1	8	360			
Examinations				1	(Graded	l/Ungraded			
	- Publication-like written summary of results obtained, data interpretation and discussion - Lab course - Graded (40%)						aded (40%)			
Requirements for					(Graded	l/Ungraded			
admission to exam		Lab journal ungraded regular participation ungraded ungraded Data presentation in the group seminar ungraded					graded			
Miscellaneous					,					

Modul: Genomics and Epi	genetics			1.1811)	CDCITÄ	PONIN	
Module Number	Workload	CP	Duration	UNIV	UNIVERSITÄT BONN cycle		
Immuno-006	135	4,5		annu			
Representative		135 4,5 1 Semester Prof. Dr. Joachim Schultze					
Providing institution	LIMES-Instit	rute					
1 Toviding mondation	Livied motio	Study cour	se	Categor	v S	Semester	
	Immunobiolo integrative s	gy: from mo	lecules to	P	3.	, om outor	
Learning objective	mechanisms	of the genorespect to the	e role and under me and the epig e immune syste he field.	jenome in (general a	nd	
Skills	Understanding Know the ket Be able to re	Understanding the principles of genomics and epigenomics Know the key methods and their applications Be able to read, understand and present fundamental issues in genomics and epigenetics					
Content	and RNA-se chromatin as and other hig Applications questions in	quencing ted ssessment. E gh throughpu of these teck cluding cell of	nic and epigene chnologies, ChIF Basic principles at single cell technologies to implifferentiation an egulation of cell	P-sequencir of single ce hnologies portant imm d maturatio	ng and op all RNA-s nunologic	oen equencing	
Requirements	none						
Courses	Kind	S	ubject	Group size	SWS	Workload [h]	
	Lecture	Genomics Epigenetic		25	2	90	
	Seminar			25	1	45	
Examinations		Prüfungs	sform(en)		graded	l/ungraded	
	Written exar	n			g	raded	
Requirements for admission to exam	None				graded	d/ungraded	
Miscellaneous							

Modul: Systems immunol Science	ogy, Bioinfo	rmatics an	d Big Data	UNIV	ERSITÄ [.]	BONN		
Module Number	Workload	СР	Duration		cycl			
Immuno-007	135							
Representative		135 4,5 1 Semester annual Prof. Dr. Joachim Schultze						
Providing institution	LIMES-Instit	ute						
		Study cour	se	Categor	y S	Semester		
	Immunobiolo integrative s	gy: from mo	lecules to	Р	3.			
Learning objective	systems imm	nunology, bi r in respect	e role and the poinformatics and to the immune he field.	d big data s	cience in	general		
Skills	Understanding and big data Know the ke	ng the princi science y methods a ad, understa	ples of systems and their applica and and presen	tions				
Content	bioinformatic sequencing and the visus datasets add	s and big dadata, the bio alization of ladicessing imm	ethods applied ata science included interpret logical interpret arge dataset. Application of the basic control of	uding the an ation of high oply such sk stions. Simu	alysis of through tills to ex late the	iput data isting circle of		
Requirements	none							
Courses	Kind	S	ubject	Group size	SWS	Workload [h]		
	Lecture	Systems immunol bioinform big data	ogy, natics and	25	2	90		
	Seminar			25	1	45		
Examinations		Prüfungs	sform(en)		gradeo	d/ungraded		
	Written exan		\\			raded		
Requirements for	None				gradeo	d/ungraded		
admission to exam								
Miscellaneous								

Modul: The immune syste regulation	em in barrier	organs an	d immune	UNIV	FRSITÄ ⁻	BONN			
Module Number	Workload	CP	Duration	OTTO	cycle				
Immuno-008	90	3		annu					
Representative	PD Dr. Heike	PD Dr. Heike Weighardt							
Providing institution	LIMES-Instit	LIMES-Institute							
<u> </u>		Study cour	se	Categor	y S	Semester			
		ogy: from mo	lecules to	Р	3.				
Learning objective	barrier orgar	ns such as sl	uainted with the kin, lung and gu important immu	t. Additiona	lly, they	should get			
Skills	Understanding the mechanic to analyze in	Understanding immunity at barrier organs such as skin, lung and gut an the mechanisms underlying immune regulation. Acquisition of methods to analyze immune reactions and host defense mechanisms in the lung gut and skin. Ability to read and to evaluate literature and to present dat							
Content	cellular complung. Immun cells and implementations regulatory cells	position of base functions a mune cell coulation, regul	er organs skin, arrier organs; Bat barrier sites o mpartments in blatory T cells, res of macrophage ors	arrier function f the body; parrier orga gulatory B	on in skir Specializ ns cells and	n, gut and eed immune other			
Requirements	none								
Courses	Kind	S	ubject	Group size	SWS	Workload [h]			
	Lecture		sytem in rgans and regulation	25	2	90			
Examinations		Prüfungs	sform(en)		graded	l/ungraded			
	Written exar		·		_	raded			
Requirements for admission to exam Miscellaneous	None				gradeo	d/ungraded			

Modul: Oral examination	on Immunology				JNIVEF	RSITÄT	BONN		
Module Number	Workload CP Duration Cycle								
Immuno-009	180 h	6	(weeks)		annual				
Representative	Prof. Dr. Sven E	Burgdorf	•						
Institution		LIMES-Institute							
		Study Cours			tegory		emester		
	Immunobiology: integrative systematics		ules to	Р		3.			
Learning Objective	immunological t	Students should acquire profound and comprehensive knowledge on immunological topics, making interconnections between the contents of individual modules on immunology.							
Skills	Profound knowl Making intercor	-		t areas	of immu	ınology	/		
	MedImmun-04,				ımuno-c	JU8			
Requirements	Immuno-001,-00						_		
Courses	Kind	su	bject	group	size S	SWS	Workload [h]		
	Examination	Immunolo	gy	1			180		
Examinations					(Gradeo	l/Ungraded		
	Oral exam						ided		
Requirements for admission to exam						Gradeo	I/Ungraded		
Miscellaneous									

Modul: Labrotation 2: Ir	nmunology			L	JNIVER	RSITÄT	BONN		
Module Number Immuno-010	Workload 360 h	CP 12	Duration (weeks	n	Cycle Every semester				
Representative	Prof. Dr. Sven B	Buradorf	8						
Institution	LIMES-Institute								
Learning Objective	Immunobiology: integrative syste Students should joining ongoing	Study Course Category Semester Immunobiology: from molecules to integrative systems (MSc) Students should acquire hands-on experience in scientific research by joining ongoing research projects in the working groups of Immunology at							
	specific immund be presented in including an info presentation of	the LIMES Institute. They should be able to design, conduct and evaluate specific immunological or cell biological experiments. The project should be presented in a written report in analogy to a scientific publication, including an informative introduction, comprehensive and logical presentation of the data, as well as a critical discussion and interpretation of the results in light of the relevant literature.							
Skills	Experimental skills in state-of-the-art immunological and cell biological techniques; ability to design scientific experiments and to critically evaluate scientific data; Soft skills in written and oral presentation of scientific results; ability to work in a team.								
Content	The scientific to of the supervisor guaranteed.	•		•			nuic scope		
Requirements									
Courses	Kind	su	bject	group s	size S	SWS	Workload [h]		
	Laboratory course	Immunolo	ду	1		8	360		
Examinations						Graded	/Ungraded		
		l, data interp	en summary or retation and o		_	Gra	aded (40%)		
Requirements for admission to exam	Lab journal regular participa Data presentation		up seminar		(ung ung	/Ungraded graded graded graded		
Miscellaneous									

Modul: Labrotation 2: G Immunology	enomics, Epig	entics and	Systems		UNIVEF	RSITÄT	BONN	
Module Number	Workload	CP	Duratio	n		Cycl	e	
Immuno-011	360 h	12	(weeks		Every semester			
Representative	Prof. Dr. Sven B	Burgdorf						
Institution	LIMES-Institute							
	;	Category		emester				
	Immunobiology: integrative syste	ems (MSc)			VP	3.		
Learning Objective	Students should joining ongoing epigenetics and be able to design should be presepublication, including presental interpretation of	research pro I systems im- gn, conduct a ented in a wri uding an info tion of the da	pjects in the warmunology at the self of t	vorking the LIN specific analog ductior s a crit	groups of the second of the scientific gy to a scientific gy, compression, compressional discussions of the second	f geno ute. Th The ientific hensive ssion a	mics, ey should project e and	
Skills	Planning and implementation of a scientific project, ability to desig scientific experiments and to critically evaluate scientific data; Hand-o experience in state-of-the-art methodology, Collecting and interpretation of project-relevant literature, Soft skills in written and oral presentation of scientific results; ability to work in a team.							
Content	The scientific to of the supervisor guaranteed.	-		-			ntific scope	
Requirements								
Courses	Kind	su	bject	grou	o size	SWS	Workload [h]	
	Laboratory course	Genomics Epigenetic Systems I			1	8	360	
Examinations		I			(Graded	/Ungraded	
		l, data interp	en summary or retation and o		lts -	Gra	aded (40%) aded (60%)	
Requirements for					(/Ungraded	
admission to exam	Lab journal regular participa Data presentation		up seminar			ung	graded graded graded	
Miscellaneous								

Workload 750 h Prof. Dr. Sv	CP 30			DELTÄT BONN
750 h rof. Dr. Sv			UNIVE	RSITÄT BONN
rof. Dr. Sv	30	Duration		Cycle
	ana Dirimanaland	1 Semester	E	very semester
IMES Insti				
	Study Cours		Category	Semester
	ogy: from mo systems (MSc		Р	4.
cientific qualific collect a semaining of experiments on duct owner of the constitute and which experiments or non-experiments	estions can be nd get an over pen scientific al strategies wn experime y and will During these descending the conclusions al setup. The nd precise and scientific exist, identify the experimental reproject-relevations for a strategies of the art met of the art met of the art met of the computations can and computations can are to answer to	e answered using rview of project-r questions for a to answer these nts. They will gather hands be experiments, controls should be can (and can y will design an swer to a specific periments and, next steps to compate the how a specific topic. These questions is for data analyst hodology and we be and negative) and their own tational setup. The can are specific questional setup. The can are specific questi	g experiment relevant literal specific topic equestions apply the one experiment the student of	s and will plan and state of the art ence using these ats will learn which in their experiments awn from a given in such a way that can be given. They cific result from their roject. If of computational bioinformatics, the c question can be all collect and get and the remaining open welop computational and conduct own and conduct own and conduct own and conduct own all be introduced into ands-on experience alysis, the students ould be included in alyses strategy and win from a given o learn whether the periment) is correctly will interpret the c experiments and, ext steps to continue their project in a from which the text
2012 /2 rittrettre/1/2011 block	xperimental onduct over the conduct over the conduct over the correct are correct. The correct are correct are correct are correct are correct are correct. The correct are co	experimental strategies onduct own experimental strategies onduct own experimental sethodology and will echniques. During the consitive and negative) ond which conclusions experimental setup. The correct and precise an will interpret scientific experiments, identify the or non-experimental resolution in the correct and precise and strategies will demonstrate the state of the art met is ing these techniques. We will learn which (positive the endiginal experiments which conclusions can experimental and compute in the conclusion of a given expend precise to answer the project. The project is the end of their the conclusion of the conclusion of their the conclusion of the conclusion o	experimental strategies to answer these conduct own experiments. They will nethodology and will gather hands be provided the provided and will gather hands be consitive and negative) controls should the provided and which conclusions can (and can experimental setup. They will design an correct and precise answer to a specifill interpret scientific experiments and, experiments, identify the next steps to concord or non-experimental master theses in interpret scientific experiments and, experiments, identify the next steps to concord non-experimental master theses in interpret scientific experiments and provided and experiments will demonstrate how a specific topic. It is trategies to answer these questions the state of the art methodology and we say the state of the art methodology and we state of the art methodology and we have the conclusions can (and cannot experimental and computational setup. The original experiments and their owe which conclusions can (and cannot experimental and computational setup. The original experiment (e.g. a good precise to answer a specific queutcome of computational analysis of the project. The project is implementation of their manual experiment is in project. Students will write a manual experiment will be a manual experiment will be a manual experiment will be a manual experime	tudents will demonstrate how a specific scientific inswered using computational approaches. They will verview of project-relevant literature and identify to cientific questions for a specific topic. They will devarategies to answer these questions and plan trategies and algorithms for data analyses. They will ne state of the art methodology and will gather hasing these techniques. During computational analytill learn which (positive and negative) controls show the original experiments and their own data analytich conclusions can (and cannot) be draw experimental and computational setup. They will also esign of a given experiment (e.g. a genomic expend precise to answer a specific question. They utcome of computational analysis of e.g. genomic iven a specific result from their data, identify the negative.

	An abstract, in which the scientific topic, the most important findings and resulting conclusions will be summarized briefly. An introduction, in which general information to understand the scientific project is provided, an overview of the current literature is given and the aim of the study is pointed out clearly A material and methods section, in which the experimental procedures are explained precisely The results of the scientific project, presented in clear and accurate figures A discussion, in which the results are interpreted and in which is described, which consequences can be drawn from the project A reference section, in which all cited literature is listed				
Skills	Planning and implementation of a scientific project Design of scientific experiments Hand-on experience in state-of-the-art methodology Collecting and interpretation of project-relevant literature Interpretation of obtained results Generation of clear and informative figures Detailed report of experimental protocols Writing of a scientific report Extracting the most important information for a summary Pointing out the impact of the obtained results for the scientific community The scientific topic of the master thesis always lies within the scientific scope of the supervisor. By this means, an optimal supervision can be				
	guaranteed.		•	· 	
Requirements	Minimum 60 0	1		0)4/0	10/ 11
Courses	Kind	Subject	Group Size	SWS	Workload [h]
	Master Thesis	Individual research project	1 1		750
Examination				Graded/ungraded	
	Evaluation of the Master Thesis by two examiners			graded	
Requirements for	Attendance of at least 20 scientific talks in the			Graded/ungraded	
admission to exam	field of biomedicine			ungraded	
Miscellaneous					