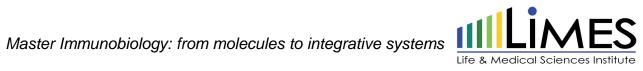
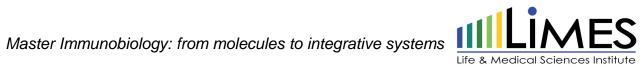


Module handbook Master study course Immunobiology: from molecules to integrative systems





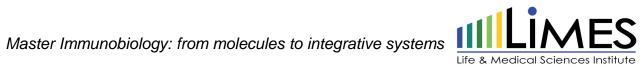
Modul: Methods in life sci	ences and s	statistics		UNI	VERSITÄ	ÄT BONN	
Module Number	Workload	СР	Duration	Cycle			
LIMES-001	90 h	3	1 Semester		Annual		
Person responsible	Prof. Dr. Ch	ristoph Thiele	9	<u>u</u>			
Deputy	Prof. Dr. Ma	atthias Schmi	d				
	Study cours			Categor		nester	
	Immunobiol integrative s	Biochemistry (MSc) Immunobiology: from molecules to integrative systems (MSc) Medical Immunosciences and Infections (MSc)					
Learning objective	Students sh and method Additionally and correct	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 kr	Profound knowledge on methodology in life sciences Being able to perform statistical analysis of obtained results					
Content	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, Graphics and visualization						
Requirements	None						
Courses	Kind	Subject		Group size	SWS	Workload [h]	
	Lecture	Methods i	n Life and statistics	85	2	90	
Examinations	Type of exa	mination			graded	/ungraded	
	Written exam				Graded		
Requirements for admission to exam							
Miscellaneous							



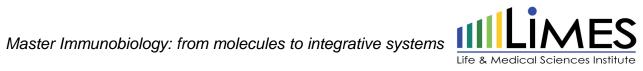
Modul: Methods course I								
		0.0	T		VERSITA	BONN		
Module Number LIMES-002	Workload 450 h	CP 15	Duration 1 Semester	Cycle Annua	Annual			
Person responsible	PD Dr. Ann							
Deputy	Prof. Dr. Günter Mayer Study course Category Semester							
					_	nester		
	Immunobiol	Biochemistry (MSc) P Immunobiology: from molecules to integrative systems (MSc)			1.			
Learning objective	Students sh	ould learn to	plan and conc ents either on th					
Skills	methods in principles of references a content of p document a	By the end of the course, students should understand the conducted methods in life science research. They should 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. Students should be able to document and analyze experimental data and present them in a writter form after completing the course.						
Content	underlying particles in Enzyme kin enzymatic and Generation Limiting diluwestern Bloom	Photometric, fluorometric and luminometric measurements, including underlying physical principles, instrumentation and calculations. Enzyme kinetics. Enzyme inhibitors. Performing and designing enzymatic assays. Fluorescence resonance energy transfer (FRET). Generation and purification of antibodies. Basic cell culture techniques. Limiting dilution in hybridoma cells. Protein gel electrophoresis and Western Blotting. Bioinformatical tools and analyses in the Life Sciences.						
Requirements	None							
Courses	Kind	Subject		Group size	SWS	Workload [h]		
	Practical course	Methods sciences	in Life	65	10	450		
Examinations	Type of exa	mination		1	Gradeo	d/ungraded		
	Written exa					d (50%)		
	Protocol				Graded (50%)			
Requirements for	Active partic	cination in pr	actical course,					
admission to exam		conducted e			Ungrad	ded		
Miscellaneous		<u>- 2</u>			,			



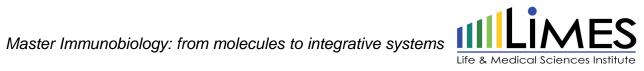
Module: Immunology I				U	NIVERSITÄ	AT BONN	
Module Number	Workload	СР	Duration	Cyc			
Immuno-001	180 h	6 on Duradorf	1 Semester	Ann	ıual		
Person responsible Deputy	Prof. Dr. Sven Burgdorf PD Dr. Bernhard Fuß						
Representative of the Medical Faculty	Prof. Dr. Lat	z					
	Study cours			Cateo	, ,	ester	
	Immunobiology: from molecules to integrative systems (MSc) Medical Immunosciences and Infection (M.Sc.)						
Learning objective	differentiate immune systems and have acquire	At the end of this module the students have acquired detailed and differentiated knowledge the cellular and humoral components of the immune 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.					
Skills	Understand Know the ke	Understanding the principles of the immune system Know the key methods and their applications Being able to read, understand and present fundamental issues in					
Content	Cellular and model organ peptides, eff molecular pa (DAMPs), P and in the co	humoral con hisms, basic fector function atterns (PAM attern recognytoplasm, sig	system from mponents of the principles of interest of immune (IPs), Damage nition receptor paling pathwammasomes,	he immune mmune rese cells, Pate e-associate rs (PRRs) ays of PRF	e system, desponses, and tern-associed molecular at the cell research	lifferent nti-microbial lated ar patterns membrane	
Requirements	None	1		T _			
	Kind	Subject		Group- size	SWS	Workload [h]	
Courses	Lecture Tutorial	Biology of response		55	1	90	
	Seminar				1	45	
	Type of exa	 mination		<u> </u>		⊥ 4 5 l/ungraded	
Examination(s)	Written exa				Gradeo		
Requirements for admission to exam	Oral presen	tation				d/ungraded led	
Miscellaneous	Janeway's I Walport, Ch Roitt's Esse	Recommended Reading: Janeway's Immunobiology; Kenneth Murphy, Paul Travers, Mark Walport, Charles Janeway; New York: Garland Science, 8E, 2012 Roitt's Essential Immunology; Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt; Wiley-Blackwell 12 th Edition 2011					



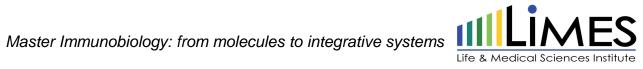
Modul: Introduction in exploid in exploid in the second in	perimental a	animal tech	niques and	UN	IVERSIT <i>i</i>	ÄT BONN	
Module Number	Workload	СР	Duration	Cycle			
LIMES-003	90 h	3	1 Semester	Annua			
Person responsible	PD Dr. Hei	ke Weighardt					
Deputy		aldemar Kola					
	Study cour			Catego		nester	
		ry (MSc) llogy: from mo systems (MSc	Р	2.			
Learning objective	models and guidelines	Students should obtain a comprehensive overview of available animal models and be acquainted with the relevant legal and bioethical guidelines of animal experimentation, as well as general rules for good scientific practice.					
Skills	models and knowledge targeting to	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 re background studies of of behavior; a (homologo CRISPR-C protection of	equirements and and environate development, unesthesia and us recombinates technology	nal models (drond animal welf mental influence metabolism, in d analgesia; go tion in embryon (); German/Eu bethics and the	are; importaces (nutrition nmunology, ene targetin nic stem ce ropean legis	ance of g n; microb neurobio g technic lls; TALE slation fo	penetic biota); in vivology and ques N and rthe	
Requirements	None						
Courses	Kind	Subject		Group size	SWS	Workload [h]	
	Lecture	Experime and statis	ntal animals tics	65	2	90	
Examinations	Type of ex	amination		I	graded	/ungraded	
	Written exa				Gradeo		
Requirements for admission to exam	None				graded	/ungraded	
Miscellaneous					•		



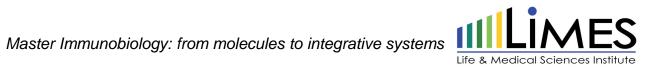
Module: Immunology II					UNIVEF	RSITÄ ⁻	T BONN	
Module Number	Workload	CP	Duration		Cycle			
MedImmun-04	180 h	6	1 Semeste	r	Annual			
Providing institution	LIMES-Institute							
Person responsible Deputy		ngard Förstei dreas Schlitz						
Representative of the Medical Faculty	Prof. Dr. Na	italio Garbi						
	Study Progr				Category	Stud	ly Semester	
	(M.Sc.) Immunobiol	Medical Immunosciences and Infection (M.Sc.) Immunobiology: from molecules to integrative systems (MSc)						
Learning objective	knowledge differentiation genetic pred Students carmediated cr	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						
Skills	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.							
Content	organization mechanism switch and s B cell subset lymphocyte mechanism	opment, T can of the Immulation of somatic hyperets, T helperemigration; in s, immunologon, gene rea	unoglobulin a ene rearrang ermutation; B cell subsets, tercellular co gical memory	and T or gement CR an regulation ommun r; epige	ell recepto t, immunog d TCR sigr tory T and lication; tol enetic patte	r locus globulinal tra B cell erance erns, g	s; n class nsduction; s; e	
Requirements	None							
	Kind	Subject		Grou size	. 31	WS	Workload [h]	
Courses	Lecture	Advanced in immune	d concepts ology	55	2		90	
	Seminar				1		45	
	Tutorial				1		45	
Everningtion(s)	Type of examination Graded/ungra Written exam Graded						ungraded	
Examination(s)								
Requirements for admission to exam Miscellaneous	Oral presen	tation				raded/ ngrade	/ungraded ed	



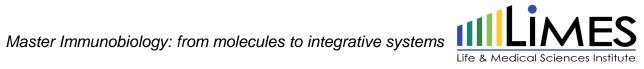
Modul: Methods course II				UNIVE	ERSIT <i>Ä</i>	AT BONN	
Module Number LIMES-004	Workload 180 h	CP 6	Duration 1 Semester	Cycle Annual			
Person responsible Deputy	PD Dr. Anne Gäbler Prof. Dr. Günter Mayer						
	Study course C				Sen	nester	
	Immunobiol	Biochemistry (MSc) P Immunobiology: from molecules to integrative systems (MSc)			2.		
Learning objective	immunologi		plan and condu cular biological e				
Skills	By the end of the course, students should understand the conducted methods in life science research. They should 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. Students should be able to document and analyze experimental data and present them in a written form after completing the course.						
Content	Molecular c in silico ana cloning wor Yeast Two their transfo tests of two test of the b DNA gel ele Protein puri proteins fro function).	loning: Using alysis of gene kflow. Hybrid Scree ormation with proteins using pait protein chapteris fication: Purif	molecular biolo sequences, ger n: Preparation o reporter-, bait- and appropriate seconds selective	f competent and prey plase elective mede media and binant and e	rategie yeast smids. ia. Aut geneti	es, practical cells and Interaction oactivation c controls.	
Requirements	None		1		2140	114/ 11 1	
Courses	Kind	Subject		Group S size	SWS	Workload [h]	
	Practical course	Methods i sciences		65	1	180	
Examinations	Type of exa	mination		(raded	/ungraded	
	Written exa					I (50%)	
	Protocol			C	Graded (50%)		
Requirements for admission to exam Miscellaneous		cipation in pra	actical course, operiments	U	ıngrad	ed	
Wildelia ledus							



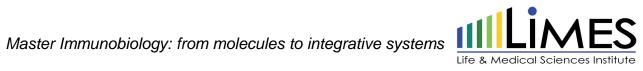
actice			UNIV	/ERSITÄ	T BONN	
Workload	СР	Duration	Cycle			
90 h	3		Annua	l		
		ok				
					nester	
Immunobiol integrative s	Biochemistry (MSc) P 2. Immunobiology: from molecules to integrative systems (MSc)					
practices of mentoring,	daily laborat data treatme	ory work docum nt etc.	entations,	publicati	ons, theses,	
practice in a a focus on being able tunethical im statistics, chunethical be	Being able to understand, judge, and apply ethics and good scientific practice in all aspects of science at all levels of scientific education, with a focus on biochemistry, systems immunology or related life sciences. Being able to spot and identify examples of fraudulent science (e.g. unethical image manipulation, plagiarism, fraudulent application of statistics, cherry-picking etc.). Learning about the consequences of unethical behavior in scientific practice. Post-publication review.					
Students will be introduced into: The rules of good scientific practice according to the guidelines of the DFG and other agencies; Examples of data manipulation and research misconduct; Keeping a laboratory notebook; Digital image ethics; Differences between honest errors, differences of opinion, and misconduct; Discussion of case studies; Interactive movie "The Lab" (https://ori.hhs.gov/TheLab/; https://www.science.org/content/article/interactive-film-misconduct-						
None						
Kind	Subject		Group size	SWS	Workload [h]	
Lecture	Scientific	c Integrity	≤65	1	90	
Type of exa	mination		1	graded	/ungraded	
None				graded	/ungraded	
	Workload 90 h Prof. Dr. Mid Dr. Martina Study cours Biochemistr Immunobiol integrative s Students sh practices of mentoring, of Being able st unethical in statistics, ch unethical be Handling m Students wi The rules of DFG and of misconduct Differences misconduct Differences misconduct (https://ori.h https://www infiltrates-la None Kind Lecture	Workload 90 h 3 Prof. Dr. Michael Famule Dr. Martina van Uelft Study course Biochemistry (MSc) Immunobiology: from mointegrative systems (MS Students should get insipractices of daily laborate mentoring, data treatme Being able to understand practice in all aspects of a focus on biochemistry. Being able to spot and it unethical image manipul statistics, cherry-picking unethical behavior in sci Handling misconduct. Students will be introduct. Students will be introduct. Students will be introduct. DFG and other agencies misconduct; Keeping a laber of good scient DFG and other agencies misconduct; Discussion (https://ori.hhs.gov/TheLhttps://ori.hhs.gov/TheLhttps://www.science.org/infiltrates-lab-rev2) None Kind Subject Type of examination Written exam	Workload 90 h 3 1 Semester Prof. Dr. Michael Famulok Dr. Martina van Uelft Study course Biochemistry (MSc) Immunobiology: from molecules to integrative systems (MSc) Students should get insight into aspects practices of daily laboratory work docummentoring, data treatment etc. Being able to understand, judge, and appractice in all aspects of science at all lea focus on biochemistry, systems immur Being able to spot and identify examples unethical image manipulation, plagiarism statistics, cherry-picking etc.). Learning a unethical behavior in scientific practice. I Handling misconduct. Students will be introduced into: The rules of good scientific practice according a laboratory notebroused into: The rules of good scientific practice according a laboratory notebroused into: The rules of good scientific practice according a laboratory notebroused into: The rules of good scientific practice according a laboratory notebroused into: The rules of good scientific practice according a laboratory notebroused into: The rules of good scientific practice according a laboratory notebroused into: The rules of good scientific practice according a laboratory notebroused into: The rules of good scientific practice according a laboratory notebroused into: The rules of good scientific practice according a laboratory notebroused into: The rules of good scientific practice according a laboratory notebroused into: The rules of good scientific practice according a laboratory notebroused into: The rules of good scientific practice according a laboratory notebroused into: The rules of good scientific practice according a laboratory notebroused into: The rules of good scientific practice according a laboratory notebroused into: The rules of good scientific practice according a laboratory notebroused into: The rules of good scientific practice according a laboratory notebroused into: The rules of good scientific practice according a laboratory notebroused into: The rules of good scientific practice according a laboratory notebrous	Workload CP Duration Cycle 90 h 3 1 Semester Annua Prof. Dr. Michael Famulok Dr. Martina van Uelft Study course Category Biochemistry (MSc) Immunobiology: from molecules to integrative systems (MSc) Students should get insight into aspects of scientific practices of daily laboratory work documentations, mentoring, data treatment etc. Being able to understand, judge, and apply ethics a practice in all aspects of science at all levels of scien a focus on biochemistry, systems immunology or rea being able to spot and identify examples of fraudulu unethical image manipulation, plagiarism, frauduler statistics, cherry-picking etc.). Learning about the cunethical behavior in scientific practice. Post-public Handling misconduct. Students will be introduced into: The rules of good scientific practice according to the DFG and other agencies; Examples of data manipumisconduct; Keeping a laboratory notebook; Digital Differences between honest errors, differences of comisconduct; Discussion of case studies; Interactive (https://ori.hhs.gov/TheLab/; https://www.science.org/content/article/interactive-finfiltrates-lab-rev2) None Kind Subject Group size Lecture Scientific Integrity ≤65 Type of examination Written exam	Workload CP	



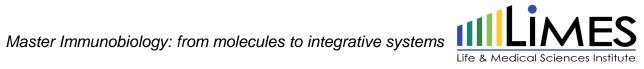
Modul: Biochemistry and	Organic Ch	emistry		UNI	VERSIT <i>i</i>	ÄT BONN		
Module Number	Workload	СР	Duration	Cycle				
Biochem-003	90 h	3	1 Semester	Annua	Annual			
Person responsible	Prof. Dr. Ch	ristoph Thiele						
Deputy	Prof. Dr. Mi	chael Famulo	k					
						nester		
	Biochemistr			WP	1.			
		ogy: from mo						
		systems (MSc						
Learning objective			e basic structi					
		•	organic reac					
			ling how some		•	sses work on		
Skills			cular enzyma nemical pathw		•			
OKIIIS			ure and funct					
			latory elemen		e enzvm	e activity		
			rinciples of O					
			nds and react					
	Being able to read and understand and present fundamental issues in							
	biochemistry and organic chemistry.							
Content	Basic protei	in structure ar	nd folding, DN	IA structure	and repl	ication,		
	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,							
	and peptides.							
Requirements	None							
Courses	Kind	Subject		Group	SWS	Workload		
				size		[h]		
	Lecture	Biochemis		65	2	90		
		organic ch	nemistry					
Evenin - Com	T				·	1/		
Examinations	Type of exa					l/ungraded		
	written exa	Written exam				d, but not ed in the		
						tion of GPA		
					Calcula	mon or or A		
Requirements for	None				graded	l/ungraded		
admission to exam					9.200	g		
	+				1			
Miscellaneous								



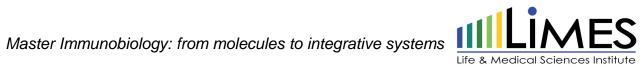
Modul: Cell Biology and Ir	mmunology			UNIV	ERSIT <i>Ä</i>	AT BONN	
Module Number	Workload	CP	Duration	Cycle			
Immuno-002	90 h	3	1 Semester	Annual			
Person responsible		en Burgdorf					
Deputy	PD Dr. Mar						
	Study cours		Category WP	Sen 1.	nester		
	Immunobio	iochemistry (MSc) mmunobiology: from molecules to ategrative systems (MSc)					
Learning objective		Students should apply fundamental knowledge on basic cell-biological and immunological topics on a cellular and molecular level.					
Skills	Understand	Understanding the key principles in cell biology and immunology.					
Content	membranes translationa proteins, sig endocytosis	s, nucleic acion Il trafficking o gnaling mech s, energy met	cell, cellular conds, protein synth f proteins, post- anisms and sec abolism in mitchem, basic princip	esis and de translationa ond messer nondria, extr	gradati I modifi ngers, c acellula	on, post- cations of sytoskeleton, ar matrix,	
Requirements	None						
Courses	Kind	Subject		Group size	SWS	Workload [h]	
	Lecture	Cell Biolo Immunolo	• •	65	2	90	
Examinations	Type of exa	mination	Į.		graded	ungraded	
	Written exa				Gradec include	l, but not d in the tion of GPA	
Requirements for admission to exam	None				graded	/ungraded	
Miscellaneous							



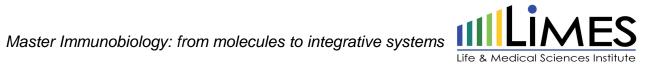
Modul: Genetics and Mole	ecular Biolo	gy		UNIVE	ERSITÄ	T BONN
Module Number	Workload	CP	Duration	Cycle		
Immuno-003	90 h	3	1 Semester	Annual		
Person responsible	Prof. Dr. Mi	chael Pankra	atz	l		
Deputy	PD Dr. Reir	nhard Bauer				
1 2	Study course C			Category	Sem	nester
	Biochemisti	ry (MSc)		WP	1.	
		logy: from m				
		systems (MS				
Learning objective			concepts of the e regulation and			
Skills	combining t	Understanding the principles of molecular biology and genetics, and combining this knowledge with biology, biochemistry, advanced genetics (genetic engineering) and genomics/bioinformatics.				
Content	structure ar replication a and monito through qua transduction	nd function of and transcrip ring gene ex antitative PC n and how to	tic cells and the f DNA and RNA tion. Design an pression expering R. Description of study such med reverse genet	and the med d cloning of e mentally in w of major mech chanisms by	chanism express hole an nanism	ns of ion vectors imals and s of signal
Requirements	None					
Courses	Kind	Subject		Group size	SWS	Workload [h]
	Lecture	Genetics Molecula		65	2	90
Examinations	Type of exa	amination			graded	ungraded
	Written exa					l, but not
						d in the tion of GPA
Requirements for admission to exam	None				graded	/ungraded
Miscellaneous						



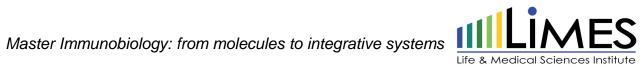
Modul: Inorganic Chemist	ry and Phys	sical Chemi	stry	UNI	VERSITÄ	T BONN		
Module Number	Workload	CP	Duration	Cycle				
Biochem-004	90 h	3	1 Semester	Annua	al			
Person responsible Deputy		Prof. Dr. Thorsten Lang Prof. Dr. Micheal Famulok						
		Study course Cate				Semester		
		y (MSc) ogy: from mo systems (MSc	WP	1.				
Learning objective		Basic understanding of atoms, molecule structure, types of reactions, types of bonding, driving force of a chemical reaction and its velocity.						
Skills	of single ato	Being capable of understanding fundamental mechanisms on the level of single atoms or small molecules.						
Content	Inorganic chemistry: atomic structure, molecular structure and bonding acids and bases, oxidation and reduction, coordination compounds. Physical chemistry: thermodynamics (kinetic gas theory, internal energy, enthalpy, entropy, free enthalpy/Gibbs energy, thermochemistry) and kinetics (reaction order, transition states, catalysis).							
Requirements	None	_				_		
Courses	Kind	Subject		Group size	SWS	Workload [h]		
	Lecture	Inorganic Chemistry	and Physical	65	2	90		
Examinations	Type of exa	mination			graded/	ungraded		
	Written exam				Graded, but not included in the calculation of GPA			
Requirements for admission to exam	None				graded/	ungraded		
Miscellaneous								



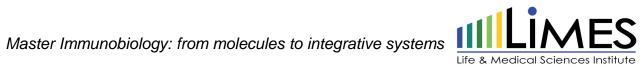
Modul: Labrotation 1: In	mmunology				UNIVE	RSITÄ	T BONN
Module Number	Workload	СР	Duration	Cy	cle		
Immuno-004	360 h	12	(weeks) 8	E۱	Every semester		
Representative	Prof. Dr. Sven E	Burgdorf		1		1	
	Study Course				egory		ester
	Immunobiology		ules to	WP		2.	
Learning	integrative syste		ade on ovnori	ionco in c	ciontifi	c roco	arch by
Objective	joining ongoing the LIMES Institute 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.						
Content	The scientific to of the supervisor guaranteed.	•		•			•
Requirements				Γ			
Courses	Kind	subject		group s		WS	Workload [h]
	Laboratory course	Immunolo	gy	1	8		360
Examinations	Type of examin	ation			G	raded	/Ungraded
	 Publication-like written summary of results obtained, data interpretation and discussion 					aded (40%) aded (60%)	
Requirements for					G	raded	/Ungraded
admission to	Lab journal				uı	ngrade	ed
exam	regular participa Data presentation		up seminar			ngrade ngrade	
Miscellaneous							



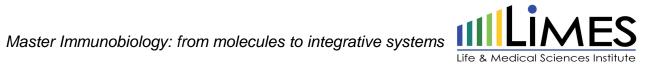
Modul: Labrotation 1: G Immunology	Genomics, Epig	enetics an	d Systems		UNIVE	RSITÄ	TBONN
Module Number	Workload	CP	Duration	С	ycle		
Immuno-005	360 h	12	(weeks)	E	very se	meste	r
Representative	Prof. Dr. Sven E	Ruradorf	8				
Nepresentative	Study Course	Burguon		Cat	egory	Sam	ester
	Immunobiology:	from molec	ules to	WP		2.	03(0)
	integrative syste		dioo to	***			
Learning Objective	Students should acquire hands-on experience in scientific research by joining 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 logical presentation of the data, as well as a critical discussion and interpretation of the results in light of the relevant literature. Planning and implementation of a scientific project, ability to design scientific experiments and to critically evaluate scientific data; Hand-on 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 topic of the lab rotation always lies within the scientific scope of the supervisor. By this means, an optimal supervision can be guaranteed.						
Requirements							
Courses	Kind	subject		group s	size S	WS	Workload [h]
	Laboratory course	Genomics Epigenetic Systems I	•	1	8		360
Examinations	Type of examina	ation		1	G	raded	/Ungraded
	Publication-like written summary of results obtained, data interpretation and discussion					aded (40%) aded (60%)	
Requirements for					G	raded	/Ungraded
admission to exam	Lab journal ungraded regular participation ungraded ungraded Data presentation in the group seminar ungraded					ed ed	
Miscellaneous							



Modul: Genomics and Ep	igenetics				ERSITÄ	TT BONN	
Module Number	Workload	CP	Duration	Cycle			
Immuno-006	135 h	4.5	1 Semester	Annual			
Person responsible		Prof. Dr. Joachim Schultze					
Deputy	-	a Aschenbre	nner		Το		
	Study cours			Category		nester	
	integrative s	ogy: from mo systems (MS	c)	Р	3.		
Learning objective			e role and unde				
			me and the epi				
	•	•	e immune syste	em including	the rel	evant	
01.31		y applied in t			.		
Skills			ples of genomic		nomics		
			and their applica		al icouc	o in	
		nd epigenetic	and and presen	i iunuamenia	ai issue	S III	
Content			nic and epigene	tic technolog	nies inc	luding DNA-	
Content			chnologies, Chll				
			Basic principles				
			ut single cell tec	•		30440.101119	
			hnologies to im		unologi	cal	
			differentiation ar				
	heterogene	ity, dynamic	regulation of cel	I activation			
Requirements	None						
Courses	Kind	Subject		Group Size	SWS	Workload [h]	
	Lecture	Genomics	s and	30 2	2	90	
		Epigeneti	cs				
	Seminar			30	1	45	
Examinations	Type of exa	mination				[/] ungraded	
	Written exa	m		9	graded		
De avvine as a set a few	Nanc					/ a all	
Requirements for admission to exam	None graded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/ungraded/				ungraded		
Miscellaneous							



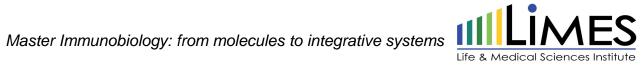
Modul: Systems immunol Science	ogy, Bioinfo	ormatics an	d Big Data	UN	IVERSIT	ÄT BONN			
Module Number	Workload	СР	Duration	Cycle	Cycle				
Immuno-007	135 h	4.5	1 Semester	Annu	al				
Person responsible		Prof. Dr. Jan Hasenauer							
Deputy	PD Dr. Tho								
	Study cours			Catego		mester			
	integrative s	logy: from mo systems (MSc	c)	P	3.				
Learning objective	systems im	munology, bio lar in respect	e role and the poinformatics an to the immune he field.	d big data	science	in general			
Skills	Understand and big data Know the ke Be able to r	methodology applied in the field. Understanding the principles of systems immunology, bioinformatics and big data science Know the key methods and their applications Be able to read, understand and present fundamental issues in genomics and epigenetics							
Content	Basic principles of the methods applied in systems immunology, bioinformatics and big data science including the analysis of sequencing data, the biological interpretation of high throughput da and the visualization of large dataset. Apply such skills to existing datasets addressing immunological questions. Simulate the circle of systems immunology, learn the basic concept of data-drived hypoth generation.					of ghput data existing e circle of			
Requirements	None	1			T	T			
Courses	Kind	Subject		Group size	SWS	Workload [h]			
	Lecture	Systems immunolobioinform big data	atics and	30	2	90			
	Seminar			30	1	45			
Examinations	Type of exa	mination			gradeo	d/ungraded			
	Written exa				graded				
Requirements for admission to exam Miscellaneous	None				gradeo	d/ungraded			



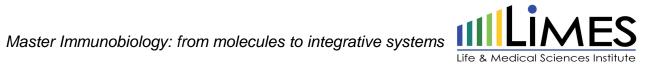
Modul: The immune syste regulation	em in barrier	organs an	d immune	UNIV	/ERSIT <i>i</i>	AT BONN		
Module Number	Workload	СР	Duration	Cycle	Cycle			
Immuno-008	90 h	90 h 3 1 Semester						
Person responsible		PD Dr. Heike Weighardt						
Deputy		aldemar Kola	nus	T _				
	Study cours			Category		nester		
		logy: from mo systems (MS		P	3.			
Learning objective	barrier orga	ns such as s	uainted with the kin, lung and gu important immu	ıt. Additiona	ally, they	should get		
Skills	Understand and the me methods to the lung, gu	an overview of the most important immune regulatory mechanisms Understanding immunity at barrier organs such as skin, lung and gut and 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 data						
Content	Development of the barrier organs skin, gut and lung; structure and cellular composition of barrier organs; Barrier function in skin, gut and lung. Immune functions at barrier sites of the body; Specialized immune cells and immune cell compartments in barrier organs Immune regulation, regulatory T cells, regulatory B cells and other regulatory cells, functions of macrophages, immune regulation in different organs and tumors					in, gut and ized immune d other		
Requirements	None							
Courses	Kind	Subject		Group size	SWS	Workload [h]		
	Lecture		sytem in rgans and regulation	30	2	90		
Examinations	Type of exa	mination			graded	/ungraded		
	Written exam graded							
Requirements for admission to exam Miscellaneous	None				graded	/ungraded		



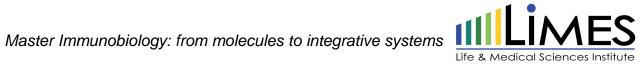
Modul: Oral examinatio	n Immunology	/		UNIVE	ERSITÄ	T BONN	
Module Number	Workload	СР	Duration	Cycle			
Immuno-009	180 h	6	(weeks)	Annual	Annual		
Representative	Prof. Dr. Sven	Prof. Dr. Sven Burgdorf					
	Study Course			Category	Sem	ester	
	Immunobiology integrative syst		ules to	P	3.		
Learning Objective		topics, makir	ofound and comp ng interconnection nology.				
Skills	Profound know Making interco		nunology tween different a	areas of imm	unolog	у	
Content			t and interconne 5, Immuno-007 a			imuno oo i,	
Requirements	Immuno-001,-0	006,-007,-008	and MedImmui	า-04			
Courses	Kind	Subject		roup S ze	SWS	Workload [h]	
	Examination	Immunolo	gy 1			180	
Examinations	Type of examir	nation	•	(3raded	/Ungraded	
	Oral exam				gra	aded	
Requirements for admission to exam				C	Graded	/Ungraded	
Miscellaneous							



Modul: Labrotation 2: Ir						ÄT BONN	
Module Number Immuno-010	Workload 360 h	CP 12	Duration (weeks) 8	Cycle Every	ycle very semester		
Representative	Prof. Dr. Sven	Burgdorf		<u> </u>			
	Study Course			Catego	•	nester	
	Immunobiology: from molecules to WP 3. integrative systems (MSc)						
Learning Objective	Students should acquire hands-on experience in scientific research by joining 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.						
Content	The scientific topic of the lab rotation always lies within the scientific scope of the supervisor. By this means, an optimal supervision can be guaranteed.						
Requirements							
Courses	Kind	Subject		Group size	SWS	Workload [h]	
	Laboratory course	Immunolo	gy	1	8	360	
Examinations	Type of examir	nation	l .		Gradeo	d/Ungraded	
	 Publication-like written summary of results obtained, data interpretation and discussion 					raded (40%) raded (60%)	
Requirements for					Gradeo	d/Ungraded	
admission to exam	Lab journal regular particip Data presentat		up seminar		ungrad ungrad ungrad	ed ed	
Miscellaneous							



Modul: Labrotation 2: G Immunology	ienomics, Epiç	genetics an	d Systems		UNIVE	ERSITÄ	BONN	
Module Number Immuno-011	Workload 360 h	CP 12	Duration (weeks) 8		Cycle Every se	meste	r	
Representative	Prof. Dr. Sven Burgdorf							
•	Study Course	<u> </u>			ategory	Sem	ester	
	Immunobiology integrative syst	ems (MSc)		W		3.		
Learning Objective	joining ongoing epigenetics and be able to design should be presequed publication, including logical presentations.	Students should acquire hands-on experience in scientific research by joining 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 logical presentation of the data, as well as a critical discussion and						
Skills	interpretation of the results in light of the relevant literature. Planning and implementation of a scientific project, ability to design scientific experiments and to critically evaluate scientific data; Hand-on 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 topic of the lab rotation always lies within the scientific scope of the supervisor. By this means, an optimal supervision can be guaranteed.							
Requirements								
Courses	Kind	subject		group	size S	SWS	Workload [h]	
	Laboratory course	Genomics Epigenetic Systems I		1	8		360	
Examinations	obtained, data interpretation and discussion						/Ungraded aded (40%) aded (60%)	
Requirements for						Graded	/Ungraded	
admission to exam	Lab journal ungraded ungraded ungraded ungraded ungraded					ed ed		
Miscellaneous					1			



Modul: Master Thesis				UNIV	ERSITÄT BONN
Module Number	Workload	СР	Duration	Cycle	
Immuno-012	750 h	30	1 Semester	Every s	emester
Representative		en Burgdorf			_
	Study Cours			Category	Semester
		ogy: from mo		P	4.
		systems (MS			
Learning objective	scientific quarthey will consider the will develop plan and consider the will develop plan and comethodolog techniques. (positive an and which experiments correct and interpret science to answer t	destions can blect and geremaining op experiments on duct own end and will buring these districtions at setup. The precise answite interest and the precise answite interest and their own as pecific to the precise question of at a specific to the precise question of their own of their own of their own of their own of their thesis, of the their thesis,	t an overview of the an overview of the scientific question and can gather hands be experiments. The gather hands are experiments, controls should be can (and can ywill design and ver to a specific oriments and, given to a specific oriments and, given to a specific question and plan are seen and plan are seen. They will do not an analyse outational analyse outational analyse on the properties of the controls should an analyse on whether the design and plan are seen whether the design and given a continue the protection of their materials and, given a continue the protection of their materials and given a continue the protection of their materials and given a continue the protection of their materials and given a continue the protection of their materials and given a continue the protection of their materials and given a continue the protection of their materials and given a continue the protection of their materials and given a continue the protection of their materials and given a continue the protection of their materials and given a continue the protection of their materials and given a continue the protection of their materials and given a continue the protection of their materials and given a continue the protection of their materials and given a continue the protection of their materials and given a continue the protection of their materials and given a continue the protection of their materials and given a continue the protection of their materials and given a continue the protection of their materials and given a continue the protection of their materials and given a continue the protection of their materials and given a continue the protection of their materials and given a continue the protection of their materials and given a continue the protection of their materials and given a continue the protection of their materials and given a continue the protection of their materials and given a continue the protection of their materials and given a	sing expering for project-releasions for a conswer these experiment in the student in the studen	mputational biology, s, the students will be answered using get an overview of ing open scientific outational strategies own strategies and into the state of the rience using these ents will learn which ded in the original d which conclusions I and computational ren experiment (e.g. answer a specific stational analysis of sult from their data, or the students are not group. The students are not group. The original decontain all projecting a scientific that the text part is in the text part is in the understand the he current literature



	 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 						
Content		topic of the master thes supervisor. By this mean	•				
Requirements	Minimum 60	СР					
Courses	Kind	Subject	Group Size	SWS	Workload [h]		
	Master Thesis	Individual research project	1		750		
Examination	Type of exam	nination		Graded	/ungraded		
	examiners	the Master Thesis by tv		graded			
Requirements for	Attendance of at least 20 scientific talks in the Graded/ungrade						
admission to exam	field of biomedicine ungraded						
Miscellaneous				_			