Immunology (BIOB 410) Syllabus: Fall 2017

Class Meeting Time and Location: 9:00 – 9:50 am; MWF FOR305
Prof: Dr. Scott Wetzel (CHCB 216, ph: 243-2168, scott.wetzel@umontana.edu)
Textbook: The Immune System by Peter Parham - 4th Edition
Class Schedule

Date	Lecture Topic	Chapters (& Pages)
	SEPTEMBER	
1	General Introduction/Intro to the Immune Response	Ch. 1, pgs. 272-282, 295-307
4	**Holiday – No Class**	
6, 8, 11	Cells & Organs of the Immune System	Ch. 1, pgs. 66-70, 272-282, 295-307
13, 15	Inflammation	Ch. 3
18	Phagocytosis and the Respiratory Burst	pgs. 49-52, 59-62
20	***Exam #1***	
22, 25	Complement Cascade	pgs. 31-41, 63-66, 381-382
27	Cytokines and Chemokines	Ch.3
29	Antigens & Immunoglobulins – Structure and Subclasses, Effector Functions	pgs. 81-91, 245-263, 282-291
	OCTOBER	
2	Antigens & Immunoglobulins – Structure and Subclasses, Effector Functions	pgs. 81-91, 245-263, 282-291
4	***Exam #2***	
6, 9	Immunoglobulins - Genetic Rearrangements	pgs. 91-109, Ch. 6
11	B Cell Biology: Germinal Centers and Humoral Responses	Ch. 9
13	T Cell Receptor (TCR) Generation and Structure/Ag Recognition	pgs. 113-121
16	Major Histocompatability Complex (MHC)	pgs. 122-145
18	***EXAM #3***	
20, 23	Antigen Processing and Presentation	pgs. 122-135
25, 27	Lymphocyte Development - B and T Cells	Ch.6, Ch.7
30	$CD4^+$ T Cell Differentiation: T_H1, T_H2, T_H17, T_{FH}, T_{Reg}	Ch. 8
	NOVEMBER	
1	$CD4^+$ T Cell Differentiation: T_H1, T_H2, T_H17, T_{FH}, T_{Reg}	Ch. 8
3, 6	Immunological Synapse, T Cell Effector Functions	Ch. 8
8	***Exam #4***	
10	**Holiday – No Class**	
13	Immunity to Viral Infections	pgs. 365-375
15	Immunity to Bacterial Infections	
17, 20	Allergy and Hypersensitivity Diseases (I, II, III, IV)	Ch. 14, Ch. 16
22, 24	**Holiday – NO CLASS**	HOLIDAY
27	Immunodeficiencies and HIV	pgs. 375-389
29	Vaccine and Immunotherapy	pgs. 308-326
	DECEMBER	
1	Vaccine and Immunotherapy	pgs. 308-326
4	Immunological Tolerance and Autoimmunity	Ch. 16
6, 8	Transplantation Immunology	Ch. 15
11	Tumor Immunology	Ch. 17
14	***Final Exam* 8-10 am**	

Immunology. We will cover aspects of innate immunity, acquired immunity, and will conclude the course talking about the role of the immune system in human disease processes. This course is a 1/3 W course and includes a significant writing component.

Study Tips*:* Immunology is an exciting and dynamic field that is, unfortunately, filled with jargon. It is HIGHLY RECOMMENDED that students make a glossary and include immunologically related terms with a definition in your own words. *Immunology has a unique language* and to understand this subject and succeed in this course, you will have to master this new language. Every exam will have a vocabulary section where you will define "immunologese" in your own words.

To succeed in this course, it is suggested that students take the time to read relevant material BEFORE each class session and that after each class, integrate lecture materials and material from the book by re-writing notes in your own words. These notes can serve as the study materials for the exams. *Lecture PowerPoints will be posted on Moodle before each lecture.*

GRADING will be based on the following:
400 points – 5 Exams (400 points each)
150 points – Final Exam. Semi-cumulative 75 pts from material after 4th exam, 75 points comprehensive
100 points – Research Article Review
Total Points Possible = 650 points

Final grades will be based upon a straight 10% grading scale based upon the total number of points (90% for A, 80% for B, 70% for C, 60% for D, below 60% = F). Late policy is outlined below.

Late Work:

Late work is strongly discouraged. **For assignments with a specified due date, a late penalty of 10% per day of tardiness will be subtracted from the grade**.

Exams: Excuses for rescheduling or missing and exam must be approved BEFORE the exam. If not pre-approved, no makeup exam will be given and an F will be recorded for the exam. Anyone missing the final exam will receive a grade of F for the entire course. *Important Note: Cheating on an exam will result in a grade of ZERO for that exam and referral for disciplinary action by the University of Montana*.

Online Supplemental Materials: There is an online Moodle supplement with all PowerPoints in PDF format at 1/page, 2/page and 4/page.

Research Article Review:

DUE DATES- **Paper #1**- Fri., November 17; 5:00 pm

Directions: Choose a 2012-2017 research article in IMMUNOLOGY that interests you, read it thoroughly, and write a synopsis. The synopsis is basically a condensed summary

of the article in your own words. Do not write a synopsis on a review article or a general topic. You must include a copy of the original research article when you submit your colloquy or your paper will NOT be graded. The paper is to be turned in by email ONLY. Your emailed paper MUST be submitted as a Microsoft Word or a Pages document.

You are highly encouraged to begin searching for your paper early. If you have any questions or would like to discuss your chosen paper, please come by my office and we can go through it.

Feedback: Students are strongly encouraged to turn in your writing assignment 1 week before the deadline to get feedback so that you can revise the document before you turn it in for grading.

Access: Please limit yourself to a top-tier Immunology related journal for your article: The Journal of Immunology, Nature Immunology, Immunity, European Journal of Immunology, Journal of Experimental Medicine or Infection and Immunity, or the general journals Cell, Science or Nature, available in the Mansfield Library. NO OTHERS WILL BE ACCEPTED WITHOUT PRIOR APPROVAL. You may scan articles in the journals or search online at the PubMed database (http://www.ncbi.nlm.nih.gov./entrez/query.fcgi) for particular key words or subjects that interest you. Remember, if there is no immunology in the article, it is not suitable for this assignment.

Purpose: To introduce prospective scientists to literature-searching and contemporary research in immunology and to read and write the "language of science". Every exam will also include a significant writing component (>30% of total points), but this will be your opportunity to write a formal paper and demonstrate your scientific writing literacy. This also fulfills the writing requirements as this is a 1/3 W course.

Format:

- 4 full pages double-spaced and typed. Page 5 and above will not be read
- Begin with a brief introduction of the topic, goals of the research, etc.
- Follow this section with a discussion of the experimental approach, and justification (rationale), but don't go into excessive detail on methodology. Why did they use immunofluorescence? Why did they do a mixed lymphocyte reaction? etc. What did they find and how did they follow up with the next experiment? If there are any flaws or missing data (e.g. controls), note them.
- Finally, discuss the authors' conclusions. Do the data presented support their conclusions? If you do not agree with the authors, explain. How could the paper be improved?
- Discuss the significance of the paper to immunology. DO NOT start the sentence with "The significance to immunology is…"

The idea is to provide the reader with the background, rationale and data, and the conclusions (take home message) so that they can understand the "story" of the paper without reading the original article. Approach it like you were telling someone the key information in the paper. I will post several examples of excellent summaries on Moodle.

Grading: 100 pts will be given based upon writing clarity, grammar, conforming to format, the overall flow of logic and how well the article is summarized. A 10% reduction in points per day will be penalized for late colloquies. Plagiarism will result in an automatic ZERO for the assignment and referral for academic discipline according the University of Montana Student Conduct code.

I recommend a new book available in the bookstore or online called "Writing Science in Plain English" by Anne Greene. It is a short, $13 book and is an easy read that will be very helpful to improve your writing for this and your other science classes.

Office Hours: Because I am required by the university to set formal office hours, I will be available after class on Mondays and Wednesdays from 10 – 11 am to meet with you. However, I do not believe in restricting your access to formal office hours and I am available to meet and discuss the class with students pretty much anytime. Please stop by my office or lab whenever it is convenient for you. If I am not available at that particular time, we will make an appointment to meet within 2-3 days. To make sure will be there and available to talk with you, you can email, call, or talk with me before or after class to set up an appointment.

Students with Disabilities (DSS Accommodations): The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and Disability Services for Students (DSS http://www.umt.edu/dss). If you think you may have a disability adversely affecting your academic performance, and you have not already registered with DSS, please contact DSS in Lommasson 154. I will work with you and DSS to provide appropriate accommodation.

Financial Aid Ramifications of Attendance: This is an issue ONLY if you withdraw from the course before the end of the semester. To be eligible to receive federal aid students must participate verifiably at least once in the course, and to be eligible to receive the full amount (whether loans or grants), must have participated through 60% of the course, or roughly the 45th day of classes. We will have an exam on October 16, which will allow me to confirm your participation through the 45th day of classes. Another way is to log into Moodle on or after October 16.

Learning Outcomes:

Cells & Organs

- The students should understand the major underlying principles of the study of immunology.
- They should be able to explain barrier functions and the general concepts of innate and adaptive immunity; comparing and contrasting all three types of immune function.
- They should be able to identify functions and distinguishing characteristics of the leukocytes that are discussed in the class: neutrophils, basophils, eosinophils, dendritic cells, macrophages/monocytes, innate lymphoid cells, and the lymphocytes.

- The students should be able to distinguish the differences between primary, secondary, and tertiary lymphoid organs and describe the major functions that take place in each.

Phagocytosis

- At the end of this lecture, the students should be able to explain the mechanism of phagocytosis, the cells that carry out this phenomenon, the role it plays in immune function, and how the phagocytic cells destroy phagocytosed pathogens and toxins.

Innate Immunity

- At the end of this series of lectures, the students should understand basic concepts of the function of the innate immune system, its role in controlling pathogens, and the effector mechanisms associated with innate activation.
- The students should be able to explain the mechanism of antigen recognition in the innate immune system – specifically the receptors for molecular patterns associated with pathogens (PAMPs) and damage (DAMPs), the Toll Like Receptors, the Inflammasome, and acute phase proteins.

Inflammation

- The students should be able to distinguish between acute and chronic inflammation. This would include the functions, characteristics, mechanism, cellular extravasation, timing, and potential damage associated with each.
- They should have an understanding of the dangers of inflammation in human disease and what the underlying causes of these inflammatory diseases are.
- **T**hey should be able to explain the constituents and function of the inflammasome.

Cytokines:

- At the end of this lecture, the students should be able to identify the general functions of cytokines and chemokines.
- They should have an appreciation for the role cytokines and chemokines play in hematopoesis and immune function. This will form the basis for the discussion of cytokines throughout the semester.
- They should also be able to explain the basic classes of cytokines, with particular attention paid to the interferons, common gamma chain, hematopoetic and gp130 cytokines.

Complement:

- The students should be able to explain the overall functions of the complement cascade, including generation of opsonins, anaphylotoxins, and the membrane attack complex.
- They should be able to differentiate between the classical, alternative and MBL pathways and be able to trace the steps of the various cascades.
- They also need to be able to explain the regulatory mechanisms that control complement activation and diseases, such as hereditary angioedema (HAE), which result of complement dysregulation.

Antigens and Immunoglobulins:

- At the end of this series of lectures, the students should be able to distinguish between antigens recognized by B and T lymphocytes, explain conformational versus linear epitopes, and identify characteristics of antigens that increase immunogenicity.
- They should know the structural components of immunoglobulin molecules including the heavy and light chains, F_c, F_{ab}, $F(_{ab}')_2$, C_H domains and the hinge region.
- They should be able to provide the characteristics of each of the 5 classes of immunoglobulins including the relative abundance, valency, effector functions, and distinguishing characteristics (size, additional components, etc).

Ig/TCR Genetic Rearrangement Lectures

- At the end of this series of lectures, the students should be able to explain the process of V(D)J recombination in the formation of Ig and TCR molecules. Specifically, they should understand recombination signal sequences (heptamer and nonamer), the 12-23 rule, the molecular process of V-D and D-J joining, the formation of hairpin loops, resolution of hairpin loops to form P nucleotides, and the generation of N nucleotides
- They should be able to explain the mechanism of generating Ig/TCR diversity, imprecise junctions, Complementarity determining regions (CDRs) and framework regions, Fr, of the Ig V regions
- They should be able to explain the process of isotype switching including the molecular mechanisms, the role of T cells and specific T cell-derived cytokines, the role of CD40-CD40L interactions and the generation of sterile transcripts.
- They also need to understand the germinal center reaction including the role of follicular dendritic cells (FDC), follicular Helper $CD4^+$ cells (T_{FH}), immune complexes, and the processes that occur in the light and dark regions of the germinal center.

MHC Lectures:

- At the end of this series of lectures, they need to be able to explain the structure and function of Major histocompatability complex Class I and Class II molecules.
- They need to explain their immunologic functions and their cellular/tissue distribution.
- They need to be able to explain the polymorphic nature of these molecules, how they evolved, and what the co-expression of these molecules means to survival of a population

Antigen Processing Lectures:

- At the end of this series of lectures, the students should be able to outline the pathways for the generation of MHC Class I and MHC Class II peptide epitopes and their loading into the MHC molecules.
- For MHC Class I they need to be able to trace the steps of MHC Class I antigen processing from the formation of the nascent Class I heavy chain in the ER, the role of chaperones (calreticulin and calnexin) in Class I formation, the generation of peptide epitopes by the immune proteosome, their transport into the ER from the cytosol via the

TAP complex, the role of tapasin and ERP57 in peptide loading and the subsequent trafficking of peptide-loaded MHC Class I to the plasma membrane via the golgi.

- For MHC Class II, they need to be able to trace the steps of antigen processing including the role of the Invariant chain (Ii), the CLiP component, the trimerization domain, the trafficking of the nascent MHC molecules to the MHC Class II loading compartment (MIIC) where it encounters antigens generated in the lysosomes, the role of cathepsins and HLA-DM in CLiP removal and loading of antigenic peptides.

T Cell Development Lectures:

- At the end of these lectures, the students should be able to explain the basic processes of positive and negative selection and how they relate to T cell maturation in the thymus, including the architecture of the thymus and the location of these processes.
- Students should also be able to explain the cellular components of this process (cTEC, mTEC, DN, DP, SP cells) and their roles in the process
- Finally, students should be able to explain the process of the differentiation of $CD4^+CD8^+$ double positive cells to each of the single positive subsets, including the role of Th-POK, strength of signal, and co-receptor engagement.

T Cell Subsets and Effector Functions

- At the end of these lectures, the students should be able to describe the distinctive characteristics (transcription factors, effector functions and cytokine products) and the mechanisms of differentiation of iTreg, nTreg, T_H1, T_H2, T_H17 and T_{FH} $CD4^+$ T cell subsets.
- They should be able to explain the formation and function of the immunological synapse.
- They need to be able to explain the effector mechanisms of $CD8^+$ T cells (cytolytic granule components and FasL) and how they relate to Natural Killer cells.

Vaccine

- At the end of these lectures they should be able to distinguish passive versus active immunity, describe the components of a successful vaccine, describe vaccine development and the necessity of vaccination for the population (herd immunity, etc.)

Hypersensitivity

- At the end of these lectures the students should be able to distinguish between the four classes of hypersensitive disease and be able to provide critical details of each (immune mediators, physiologic responses, exposure routes, nature of antigens involved, disease symptoms and progression, and treatments).

Immunodificiencies

- They need to be able to distinguish primary and secondary immunodeficiencies.
- They should be able to describe and provide characteristic symptoms, molecular basis, and the diagnostic criteria for several primary immunodeficiency diseases such as X-linked agammaglobulineima, X-linked hyper IGM syndrome, SCID, bare lymphocyte syndrome, and ADA deficiency.

Transplant Immunology

- After these lectures, the students should be able to describe the three types of rejection to solid tissue transplants (hyperacute, acute, and chronic) including the mechanisms, whether they respond to immunosuppressive therapy, methods to prevent rejection.
- They should be able to explain the role of Major and minor histocompatability antigens, the mechanisms of typing tissues to limit rejection and the mechanism of immunosuppressive dugs (cyclosporine A and FK506)
- They need to be able to describe the mechanisms and treatment of graft versus host disease (GVHD) after bone marrow transplantation.

Tolerance and Autoimmunity

- At the end of this series of lectures, they should be able to describe mechanisms of central and peripheral tolerance.
- They should be able to relate central tolerance to the T cell development (positive and negative selection)
- They should be able to explain the generation of immunological tolerance and how it differs from negative selection

PLEASE NOTE: You are bound by the University of Montana student conduct code. All work will be performed solely by the student. Plagiarism and cheating of any kind will result in referral for disciplinary action and you will receive a zero on the assignment. This will significantly impact your final course grade. ALL electronic devices (phone, iPad, etc.) are to be POWERED OFF and stored in bags during examination periods. If your phone or other electronic device disrupts the exam in any way, your will lose 25 points from your total grade on that exam – TURN IT OFF!