Immunology & Infectious Diseases, Spring 2017  
Tuesdays and Fridays, 10.05-11.25  
Classroom: 1D-409

Instructor  
Johan Öckinger  
Ph.D. in Experimental Neuroscience (Karolinska Institutet, Stockholm, Sweden, 2009),  
M.Sc. in Biomedicine (Karolinska Institutet, 2004). Assistant Professor in Respiratory  
Medicine (Karolinska Institutet, since 2016). Postdoctoral research at Karolinska  
Institutet (2012-15) and Harvard School of Public Health (Boston, MA, 2009-11).  
Conducting research in pulmonary immunology, autoimmunity and immune-environment  
interactions. With DIS since 2016.

Course description  
This course will provide students with a fundamental understanding of immunology and infectious diseases  
at an advanced level. Students will learn about the immune system and how it is can fight off infection. They  
will also learn how an immune response can fail. Examples of different types of clinically relevant infectious  
agents and which type of immunity they activate will be given. In addition, students will learn how infectious  
agents can overcome the natural immune response and cause disease. The course will also illustrate how  
the immune response against these agents can be manipulated through the use of vaccines.

Prerequisites  
One year of biology, one semester of chemistry plus an introductory course in molecular biology/genetics at  
university level

Expected learning outcomes  
After successful completion of this course, students will be able to:  
• Describe the structure and function of the immune system  
• Describe how cells interact with other cells in the body as well as with pathogens  
• Classify the different types of immune responses  
• In detail describe the immunological events occurring in response to various infectious agents  
• Explain the virulence mechanisms used by different infectious agents  
• Explain how the infectious agents can overcome an immune response and cause active disease  
• Explain in detail the basis behind vaccinology and vaccine development  
• Critically analyze findings in immunological research

Required readings  
- Selected sections from Murray, Rosenthal, Pfaller: Medical Microbiology, 2012 (posted on Canvas)  
- Peer reviewed articles posted on Canvas

Teaching methods  
Different teaching formats may be used, such as interactive lectures, class discussions, critical analysis of  
research (both individually and in groups), field studies, and a final project. Case studies as well as current  
articles on relevant topics will be used, and students will take part in presenting these. Students are  
expected to engage actively in oral presentations, discussions, group work and exercises.
Guest lecture(s)
TBA

Case seminar
The case “Infection, inflammation and the danger of stepping on glass” will be used as an illustration of infection and immune activation. Students should study the case in order to be able to discuss it during the seminar. The seminar itself is not a test, but active participation is mandatory and will be. After the seminar, the students should submit a 2-page summary focusing on a main topic from the case, see Appendix A

Journal clubs
Journal clubs consists of group work, presentations and class discussions. They serve as an exercise of critical thinking, critical reading, teamwork, structuring information for presentations and maturation of your presentation skills. Students will be divided in groups of 3-4 students/group, each responsible for presenting a scientific paper focused on an infectious disease or pathogenic microorganism. The findings and conclusions of the paper should be presented by the group and discussed in a clear way within 15-20 min. The journal club presentation should have a logical and clear structure and provide most relevant information on the background, methods, conclusions and perspectives of the paper, as well as critique of the methods, results and conclusions. The rest of the class should read the paper and prepare 1-2 questions each, for the presenting group.

Final project
At the end of the semester the students will work on a research project of their choosing where the focus will be either on a specific disease of the immune system (including autoimmunity, immunodeficiency and asthma/allergy) or on a defined infectious agent. The students should make an oral presentation of their project, and submit a written report. See Appendix B for details.

Field studies
- February 1st (8.30-12.30): Karolinska Institutet, Center for Molecular Medicine. Includes visit to research lab(s) and short talks by junior scientists, introducing current research in various fields of Immunology and Infectious Diseases.
- March 8th (13.00-17.00): TBA

Evaluation and Grading
To be eligible for a passing grade in this class all of the assigned work must be completed. Late assignments will be accepted, but the grade for the paper will be reduced. The factors influencing the final grade and the proportional importance of each factor is shown below:
### DIS Science & Health contacts

Lisbeth Borbye, Program Director  
Susana Dietrich, Assistant Program Director, sd@dis.dk, Tel: +45 3376 5442

### Expectations of Students & Code of Conduct

- Laptops may be used for note-taking, fact-checking, or assignments in the classroom, but only when indicated by the instructor. At all other times laptops and electronic devices should be put away during class time.
- Reading must be done prior to the class session; a huge part of the class is dependent on discussions in class.
- Students need to be present and participating to receive full credit. The final grade will be affected by unexcused absences and lack of participation. Remember to be in class on time!
- Classroom etiquette includes being respectful of other opinions, listening to others and entering a dialogue in a constructive manner.
- Students are expected to ask relevant questions in regards to the material covered.

### Policies

- **Disability and Resource concerns:** Any student who has a need for accommodation based on the impact of a disability should contact Sean Green (sgr@dis.dk) to coordinate this. In order to receive accommodations, students should inform the instructor of approved DIS accommodations within the first two weeks of classes.

- **Attendance:** Students are expected to attend all DIS classes when scheduled. If multiple classes are missed the Office of Academic Support will be notified and will follow-up to make sure, that all is well. Absences will jeopardize grades and academic standing at DIS. Allowances will be made in cases of illness, but in the case of multiple absences a doctor’s note is required.

- **Academic Honesty: Plagiarism and Violating the Rules of an Assignment**  
  DIS expects that students abide by the highest standards of intellectual honesty in all academic
work. DIS assumes that all students do their own work and credit all work or thought by others. Academic dishonesty will result in a final course grade of ‘F’ and can result in dismissal. The students’ home universities will be notified. In such cases, DIS reserves the right to request that written student assignments be turned in electronically for subjection to plagiarism detection software. See the Academic Handbook for more information, or ask your instructor if you have questions.

Canvas

Canvas is a web-based system that allows you to access course resources and communicate with your classmates and faculty. To access the DIS Canvas, you can go to the DIS homepage and click the ‘Canvas’ link, or go to: https://disabroad.instructure.com/ You can also download the Canvas App (By: Instructure) on iPhone and Android mobile smart phones.
# Course Schedule Overview

## Semester Overview

<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture Content</th>
<th>Required readings</th>
<th>Lec. #</th>
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<tbody>
<tr>
<td><strong>MODULE 1</strong></td>
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<td><strong>All references to sections in “Janeway’s Immunobiology”.</strong></td>
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| Friday Jan 20th | **Introduction**  
- Basic concepts in Immunology  
- Cells of the immune system  
- The first lines of defense | 1-1 through 1-7  
2-1 through 2-4. | 1      |
| Tuesday Jan 24th | **Innate Immunity I**  
- Principles of Innate immunity  
- Pattern recognition  
- Inflammation | 3-1 through 3-10 | 2      |
| Friday Jan 27th | **Innate Immunity II**  
- Induced innate  
- Complement | 2-5 through 2-16  
3-13 through 3-18, and 3-24 | 3      |
| Tuesday Jan 31st | **Innate Immunity III**  
- Innate response to virus  
- Intro to adaptive Immunity I | TBA  
1-8 to 1-20 | 4      |
| Wednesday Feb 1st 08.30-12.00 | Field study  
Karolinska Institutet, Center for Molecular Medicine | |        |
| Friday Feb 3rd | **Test 1**  
- Intro to adaptive Immunity II | (60 min)  
1-8 to 1-20 | 5      |
| **Core Course Week** | February 6-11 | **No Class** |        |
| Tuesday Feb 13th | **Recognition of antigen I**  
- Antigen recognition by B-cell receptors  
- Antigen recognition by T-cell receptors | 4-1 through 4-9, 5-1 through 5-8 and 5-12 through 5-19  
4-10 through 4-19, 5-9 through 5-11 | 6      |
| Friday Feb 17th | **Recognition of antigen II**  
- Antigen presentation to T-cells  
\textit{Introduction to journal clubs and the final project} | , 6-1 through 6-8 and 6-11 through 6-16 | 7      |
<p>| Tuesday Feb 21st | <strong>Development and survival of lymphocytes</strong> | 8-1 through 8-2, 8-6 through 8-10, 8-14 through 8-29 | 8      |</p>
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<th>Lecture Content</th>
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<td><strong>MODULE 2</strong></td>
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<tr>
<td>Friday Feb 24th</td>
<td><strong>Adaptive Immunity I</strong></td>
<td>9-1 through 9-19, and 9-25 through 9-28.</td>
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<td>• T cell-mediated immunity</td>
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<td><strong>Break</strong></td>
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<td><strong>February 25 – March 6</strong></td>
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<td>Tuesday March 7th</td>
<td><strong>Adaptive Immunity II</strong></td>
<td>9-20 through 9-24</td>
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<td>• T cell-mediated immunity</td>
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<td>Wednesday March 8th</td>
<td><strong>Field study</strong></td>
<td>TBA (Biotech/pharmaceutical company in the Stockholm area)</td>
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<td>13.00 – 17.00</td>
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<td>Friday March 10th</td>
<td><strong>Adaptive Immunity III</strong></td>
<td>10-1 through 10-25</td>
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<td></td>
<td>• Humoral immune response</td>
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<td>Tuesday March 14th</td>
<td><strong>Dynamics of adaptive immunity</strong></td>
<td>11-1 through 11-8, 11-13 through 11-19</td>
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<td>Friday March 17th</td>
<td><strong>Case seminar</strong></td>
<td>Case: Infection, inflammation and the danger of stepping on glass</td>
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<td><strong>Long Study Tour</strong></td>
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<td><strong>March 18-26</strong></td>
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<td><strong>No Class</strong></td>
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<td>Tuesday March 28th</td>
<td><strong>Mucosal immune system</strong></td>
<td>12-1 through 12-5, 12-7 through 12-11, and 12-20</td>
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<td><strong>Allergy</strong></td>
<td>14-1 through 14-2, 14-6 through 14-10 and 14-14</td>
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<td>Friday March 31st</td>
<td><strong>Autoimmunity</strong></td>
<td>15-1 through 15-7, 15-10 through 15-12, 15-17, 15-22 and 15-24 through 15-26</td>
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<tr>
<td>Tuesday April 4th</td>
<td><strong>Immunodeficiency diseases</strong></td>
<td>13-7 through 13-18 and 13.22</td>
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<td><strong>Intro Journal club</strong></td>
<td>JC presented by Instructor</td>
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<td><strong>Tuesday April 11th</strong></td>
<td>Immunology of infection</td>
<td>11-11, 13-1 through 13-6, and “Introduction to Medical Microbiology” (Murray)</td>
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<td>10.05-13.00</td>
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<td>Classroom: TBA</td>
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<td></td>
<td>Bacterial Infections</td>
<td>12-13 to 12-17 + “Mechanisms of Bacterial Pathogenesis” (Murray)</td>
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<td>(Enteric: E-coli, Shigella)</td>
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<td>(Airway and sepsis: pneumococci)</td>
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<td><strong>Journal Club A</strong></td>
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<td><strong>Tuesday April 18th</strong></td>
<td>Viral infections</td>
<td>3-19 through 3-23, 13-24 through 13-34, and “Mechanisms of Viral Pathogenesis” +</td>
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<td>13.15-16.10</td>
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<td>“Role of Viruses in Disease” (Murray)</td>
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<td><strong>Journal Club B</strong></td>
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<td>Parasites and Mycobacteria</td>
<td>9-29 through 9-31, 10.25, “Mycobacteria” and “Pathogenesis of Parasitic Diseases”</td>
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<td>Parasites (Malaria)</td>
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<td>Mycobacteria Tuberculosis</td>
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<td><strong>Tuesday April 25th</strong></td>
<td>Vaccination</td>
<td>16-19 through 16-31 and 13-35</td>
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<td>13.15-16.10</td>
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<td>Immunological tools in research</td>
<td>A-6, A-12, A-16 through A-18 and A-22</td>
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<td>Q&amp;A regarding final project</td>
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<td>Course summary</td>
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<tr>
<td><strong>Tuesday May 2nd</strong></td>
<td>Test 2</td>
<td>80 min</td>
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<td>13.15-14.35</td>
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<td>Classroom: TBA</td>
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<td>Oral Presentations of Immunology and infectious</td>
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<td>Disease Research project</td>
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<td><strong>May 9, 10 or 11</strong></td>
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<td>Disease Research project</td>
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<td><strong>May 23</strong></td>
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Appendix A:

Case seminar

*Infection, Inflammation and the Danger of Stepping on Glass*
Adopted from a case by Klas Kärre, Kl.

**Objectives**
From the study of a clinical case get an enhanced understanding of how the immune system develops and functions. The intention with these seminars is that you, together in the group and with a participating teacher, discuss the case as a platform to help you understand and repeat basic concepts in immunology.

**Instructions**
You should (individually or in a group) go through the case prior to the seminar. Everyone in the class should be able to discuss basic concepts emerging from the case at the seminar. This seminar is thus meant to help you to develop your knowledge in communication with the class and the teacher. The seminar itself is not a test, but an opportunity to develop a deeper understanding of immunology. Your contribution to the seminar (including discussions, questions, and description of immunological events will be included in the participation grade.

**Case report**
After the seminar, you should submit a written report summarizing the key elements discussed under #2. No drawings are required for the report. The recommended length is approx. 2 pages, single-spaced, 12 pt, but correct and comprehensive description is more important than the absolute length. Deadline for submission of report: April 4th (23.59). Upload the report as a word or pdf file via Canvas.

**Instructions for the Case Report**
Describe the various cells and molecules of importance in the generation of an adaptive immune response against bacteria. Focus on the events taking place in the regional lymph node during day 1-7 of the infection. Make sure to include the following cells, molecules and events, and describe their functions:
- APC/Dendritic cells, B-cells, plasma cells, T-cells, CD4+, CD8+ Adhesion molecules, Cytokines, Chemokines, Germinal center, Antigen presentation, Lymphocyte recirculation.
Infection, Inflammation and the Danger of Stepping on Glass

Kim is a 22-year old immunology student. She attends an immunology course in the Stockholm archipelago and enjoys sailing during one of the afternoons. During a brief stop close to a small island Kim goes for a swim and decides to swim all the way to the little island. As Kim wades ashore she steps on a piece of glass from a broken bottle, and gets a deep cut. She manages to pull out the glass piece, and there is First Aid equipment on the boat with which a nice little bandage is made. The next morning however, Kim has a throbbing pain in the foot, and when she peels off the bandage the cut is inflamed due to infection.

1. What is happening in Kim’s foot?
   a. Describe the classical signs of inflammation.
   b. Describe the phases or “purposes” of the inflammatory reaction
   c. Describe cellular and/or molecular activities or components of Kim’s innate (constitutive) immune system that are activated during the initial eight hours.

Two days later the cut is still worse – it is more painful and swollen, and there is now a yellow liquid flowing from it and there are slightly swollen lumps in Kim’s groin.

2. Describe the various cells and molecules of importance in the generation of an adaptive immune response against bacteria. Make a schematic drawing of their different locations, and indicate which cells travel from one place to another. Then focus on the events taking place in the regional lymph node during day 1-7 of the infection.

   Include keywords such as: APC/Dendritic cells, B-cells, plasma cells, T-cells, CD4+, CD8+ Adhesion molecules, Cytokines, Chemokines, Germinal center, Antigen presentation, Lymphocyte recirculation.

3. Describe how newly synthesized antibodies can help clearing the ongoing infection, in different ways

After yet another few days, the inflammation around the wound subsides and a scar tissue is being formed. The pain has also vanished and swollenness of the groin lymph node has vanished. Kim has almost completely recovered from the incidence and has, during these days, also decided to be more careful when swimming in unknown waters.

4. How is the specific immune response down-regulated?
Appendix B

Final project

At the end of the semester the students will work on a research project of their choosing where the focus will be either on a specific disease of the immune system or on a defined infectious agent or disease. The project could either focus on a novel topic, or a disease or microorganism previously discussed during the course. However, the students should not choose the same topic for their journal club and their final project. All students should select a unique topic for their project, and this will be organized on a “first come, first serve” basis.

The deadline for selection of a topic for the final project is April 4th. Selections should be submitted via Canvas

Oral presentation:

Schedule: TBA (May 9-11)

The main topics of the project should be summarized during a 10-minute oral presentation, using PowerPoint. The current understanding of the disease, immune response, symptoms and treatment should be presented in a concise but comprehensive manner. Additional relevant information, as outlined below, should also be included. The presentation will be followed by questions from the examiner and other students. Students will also act as

Written report:

Deadline: May 5th (23.59). Upload the final report as a word file to Canvas. Also upload the Abstract on a separate page including Title and name

A report on the selected topic should summarize the relevant information on 3 to 5 pages (single spaced, 12 pt). The report must include a description of the immunological events relevant to the selected topic, but could also include several other aspects of the disease. The report should cite an appropriate number of relevant references (minimum 5), and the references should be listed on 1-2 pages (not included in the page count for the report). In addition the report should include an Abstract (maximum 250 words), submitted on a separate page

The report should be divided into a suitable number of sections. Recommended sections: Introduction, Etiology, Immunological Mechanisms, Symptoms, and Treatment.

Suggested sections to include if applicable: Genetic factors/predisposition, Environmental Factors, Molecular Mechanisms of Disease/Symptoms, Controversies in the field, Public Health issues, Disease Prevention, Outbreaks/Epidemics/Pandemics, Future Perspectives

The abstracts will be distributed to all students in the class, before the oral presentations.
Suggested topics (selection of topics in NOT limited to these suggestions):

- **Infectious agents and diseases:**
  - HIV/AIDS
  - RS-virus
  - JC-virus
  - Herpes
  - EBV
  - Zika virus
  - Influenza
  - Calici virus
  - Varicella zoster
  - Polio
  - TBE
  - Dengue fever
  - Tuberculosis
  - Malaria
  - Sleeping sickness
  - Borrelia / Lyme disease
  - E. coli
  - Pneumococcal infection

- **Autoimmune diseases:**
  - Multiple Sclerosis
  - Rheumatoid arthritis
  - SLE (Lupus)
  - Diabetes type I
  - Guillain-Barré syndrome
  - Psoriasis
  - Coeliac disease
  - Autoimmune Thyroiditis
  - Autoimmune Encephalitis

- **Inflammatory diseases:**
  - Crohn's disease
  - Ulcerative colitis
  - Sarcoidosis
  - Allergy
  - Asthma
  - Severe combined immunodeficiency