

**ImmunoBiology, 28 June 2013**

**Naam:**

**Collegekaartnummer:**

**Multiple choice questions (each question is 3 points unless stated otherwise):**

1. Natural killer (NK) cells do not:

- a. have receptors that recognize MHC molecules
- b. contain perforin.
- c. respond to virus infected cells.
- d. provide help for development of antibody responses.
- e. generate memory responses.

2. The classical and alternative pathways meet at complement component:

- a. Factor D
- b. C5
- c. C3
- d. C4b
- e. TLR4

3. Plasma cells:

- a. are derived from T-cells
- b. develop into B-cells
- c. secretes the antigen it recognizes
- d. secrete large amounts of single specificity antibodies
- e. like macrophages are very efficient in eliminating dead cells.

4. Adaptive T- and B-cell responses have been demonstrated to be present in:

- a. The horseshoe crab.
- b. Frog.
- c. Fruit Fly.
- d. Marine sponges.
- e. Sea urchin

5. Which of the following is not a feature of germinal center B-cells:

- a. Immunoglobulin gene class switching.
- b. Apoptosis.
- c. Formation of immunological synapse on the surface of FDC.
- d. Somatic hypermutation.
- e. Proliferation.

6. Which of the following is not produced by cytotoxic T cells?

- a. IFN- $\gamma$
- b. CD40 ligand
- c. TNF- $\alpha$
- d. lymphotoxin
- e. perforin

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7. The processing of cytosolic proteins involves:

- a. Transport into late endosomes.
- b. Proteasome-mediated cleavage.
- c. Displacement of invariant chain.
- d. Displacement of beta<sub>2</sub>-microglobulin.
- e. Binding to the MHC class II groove.

8. Which of the following is not correct? 'Natural antibodies' are typically:

- a. autoreactive.
- b. polyspecific.
- c. reactive with bacterial carbohydrates.
- d. high affinity IgG.
- e. found in all healthy individuals.

9. Dendritic cells take up, process or present antigen by several routes, **except** one of the routes below. Which one?

- a. Receptor-mediated endocytosis of bacteria using the mannose receptor
- b. Macropinocytosis of soluble antigens
- c. Uptake of viruses using Toll-like receptor TLR9
- d. Cross-presentation from the MHC class II pathway to the MHC class I pathway
- e. Cross-presentation from incoming infected dendritic cells to healthy resident dendritic cells in secondary lymphoid tissue.

10. Bare lymphocyte syndrome leading to a lack of HLA class II molecule expression is due to a defect in

- a. transcriptional regulators of HLA class II
- b. the  $\beta$ 2m chain that is part of HLA class II molecules
- c. TAP peptide transporter
- d. RAG-1 or RAG-2
- e. thymic development.

11. Males engrafted with HLA-identical bone marrow from their sisters develop graft-versus-host disease **mainly** because \_\_\_\_\_.

- a. T cells develop in the male thymus that are not tolerant to minor histocompatibility antigens expressed by the sister
- b. mature T cells in the graft have specificity for male-specific minor histocompatibility antigens
- c. there are differences between the sexes in how self proteins are modified post-translationally
- d. NK-cell alloreactions occur
- e. residual female hormones in the graft cause upregulation of HLA class I on male dendritic cells presenting minor histocompatibility antigens.

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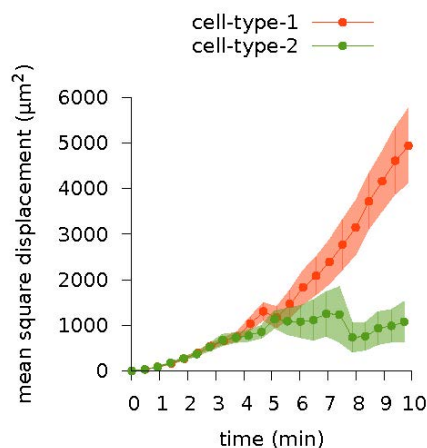
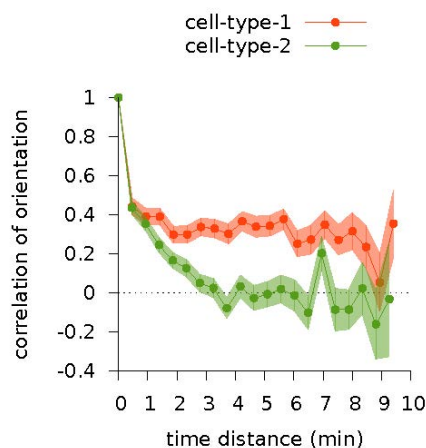
14. Which of the following explains why the first baby born to a Rh<sup>-</sup> mother and a Rh<sup>+</sup> father does not develop hemolytic disease of the newborn?

- a. Fetal erythrocytes do not cross the placenta and therefore do not stimulate an antibody response.
- b. The antibodies made by the Rh<sup>-</sup> mother during the first pregnancy are predominantly IgM and have low affinity for the rhesus antigen.
- c. Maternal macrophages in the placenta bind to anti-rhesus antibodies and prevent their transfer to the fetus.
- d. Hemolytic disease of the newborn is a T-cell-mediated disease and maternal T cells do not cross the placenta during pregnancy.
- e. The rhesus antigen is not immunogenic and does not stimulate an antibody response.

15. Which of the following is not correct? T cell cross-reactivity:

- a. is negligible, because VDJ rearrangements do not allow for cross-reactivity.
- b. provides immunity towards related pathogens.
- c. creates holes in the T cell repertoire, and thereby decreases the number of T cell responses to a pathogen.
- d. might help maintaining viral control when T cell escape mutants evolve.
- e. can generate autoimmunity.

16. We analyzed cell track data sets from intravital imaging experiments. Based on the mean square displacement and auto correlation plots, which one of the statements is correct?



- a. Cell type 1 is moving randomly, and type 2 directionally.
- b. Cell type 1 and 2 are moving randomly.
- c. Cell type 1 and 2 are moving directionally.
- d. Cell type 1 is moving directionally and type 2 randomly.

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**Short Questions:**

**I. (6 points)** Match the HLA molecules mentioned on the right to the statements that best describes their function on the left. More than one answer may be correct, if so give them all. Use the space indicated by “\_\_\_” to fill in your answer.

___ a. an intracellular, monomorphic MHC class I isotype whose function is unknown	1. HLA-A, HLA-B, HLA-C
___ b. form ligands for receptors on NK cells	2. HLA-E, HLA-G
___ c. participate in peptide loading of MHC class II molecules	3. HLA-F
___ d. present antigen to CD4 T cells	4. HLA-DP, HLA-DQ, HLA-DR
___ e. present antigen to CD8 T cells	5. HLA-DM, HLA-DO

**II. (8 points)** Make your own multiple choice question on macrophages and answer the question. The question should have four (might also be five) possible answers, and the quality of the question and the multiple choice answers matter.

**III. (8 points)**

Name two reasons why NK cells could be considered as part of the adaptive immune response and two reasons why they could be considered as part of the innate immune response.

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**IV. (5 points)**

The following model is describing a viral infection. T stands for target cells, and I for infected cells. Explain in your own words each term of the equations:

$$\frac{dT}{dt} = \sigma - \delta_T T - \beta T I, \quad \frac{dI}{dt} = \beta T I - \delta I$$

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**Open Question (25 pnts):**

Write a short essay (at least half a page, max. of one page) on T cell development. Make sure that you cover the following list of concepts: RAG, thymocytes, epithelial cells, negative selection, positive selection, CD4, CD8, MHC restriction, AIRE, VDJ gene rearrangement.