Basic Immunology
(Dentistry)

Lecture 1.

Introduction.

Components and structure of the immune network.

Immunological recognition.

University of Pécs, Medical School, Department of Immunology and Biotechnology

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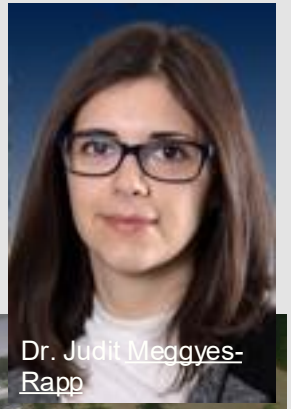
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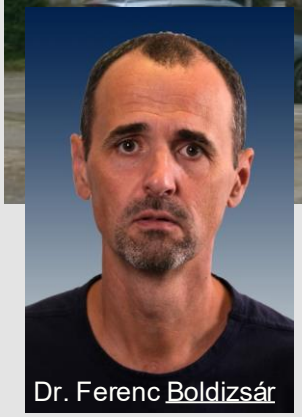
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Introduction 1.

- Please follow our website www.immbio.hu through the whole semester for up-to-date informations about our education. Please pay attention that the published lecture slides alone are not suitable for learning the subject Basic Immunology because they are incomplete without the live explanations and additions given on the lectures by our teachers. For the complete understanding of our topics we expect that students take part on the lectures and make their own notes as well as the use of the Textbook: Abul K. Abbas et al.: Molecular and Cellular Immunology 10th Edition 2021.

Introduction 2.

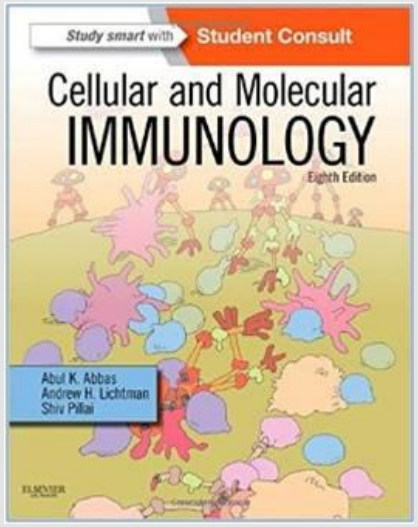
- **2 lectures / week** (preparation of own lecture notes!) Name list will be led every week. **Maximum 3 absences allowed!**

- **Exam:** online test exam in **"moodle.pte.hu"** from the lectures in the Lecture Rooms of the University. Evaluation: minimum level: 60%; satisfactory 60-71%, average 72- 77%, good 78-83%, excellent 84%

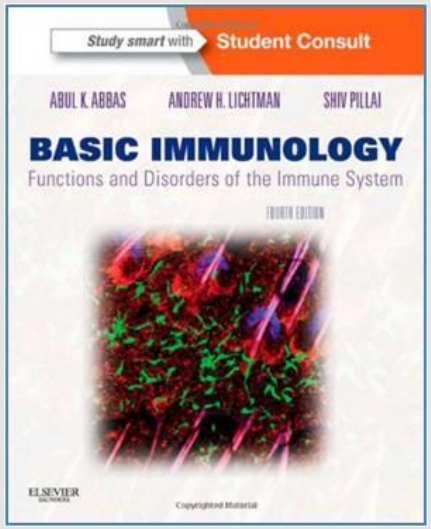
- **Website:** www.immbio.hu

Introducing the subject 3.

- Our official books you can learn from:



Abul K. Abbas, Andrew H.H. Lichtman, Shiv Pillai: **Cellular and Molecular Immunology**, 8th edition, 2015.

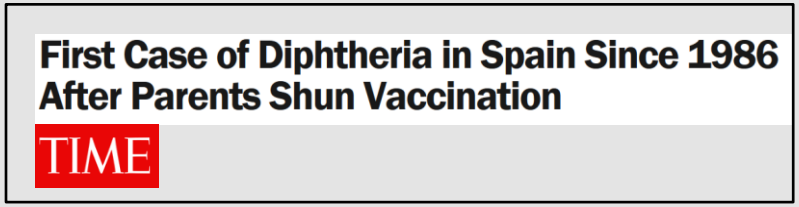


Abul K. Abbas, Andrew H.H. Lichtman, Shiv Pillai: **Basic Immunology**, 4th edition, 2012.

- **Attention!** Our department has never published or lectored any notes for students, therefore we recommend you to be cautious in case you decide to study from them.

Introducing the subject 3.

- What makes immunology worth studying?
  - The immune system is involved one way or another in almost all human pathological conditions.
  - Many of the laboratory diagnostics are based on immunological methods. (see later)
  - More and more diseases get treatable by manipulating the immune system. (see later)
  - Autoimmune diseases affect 7-8% of the population, they are chronic and generally incurable, yet many can be treated effectively. (see later)
  - The number of immunocompromised patients increased recently. (Due to therapeutic immunosuppression and HIV, see later)
  - Laypeople also seem to have strong opinions regarding immunology. → Media tends to mix medical facts with quackery and pseudoscience.



A news report from June of 2015

Topics

- Molecules
- Cells
- Organs
- Functions

Special emphasis on topics related to dentistry.

2-Sep	1	Introduction. Components and structure of the immune network. Immunological recognition.
	2	Structure of the lymphoid organs.
9-Sep	3	Cells of the immune system, myeloid cells.
	4	Innate immunity. Pattern recognition.
16-Sep	5	Innate immunity. Inflammatory reaction.
	6	Cells of the immune system, lymphoid cells. CD markers.
23-Sep	7	Recognition molecules of the adaptive immune system: immunoglobulins.
	8	Recognition molecules of the adaptive immune system: T cell receptor.
30-Sep	9	MHC and antigen presentation.
	10	Communication between the cells of the immune system. Cytokines.
7-Oct	11	Communication between the cells of the immune system. Adhesion molecules, coreceptors.
	12	Organization and rearrangement of the antigen receptor genes.
14-Oct	13	Primary B cell development: developmental stages and checkpoints.
	14	T-cell development in the thymus. Stages of maturation and the role of environmental factors.
21-Oct	15	Beginning of the immune response: early stages of T/B cell interaction, CD3 complex and signal transduction, BcR signal transduction. Co-stimulation. T-dependent
	16	Components of the humoral immune response: extrafollicular reaction and germinal center.
28-Oct	17	Effector functions of immunoglobulins. Antigen-antibody reactions.
	18	The complement system
4-Nov	19	Immunological memory. Comparison of the primary- and secondary immune responses.
	20	Vaccination.
11-Nov	21	Effector mechanisms of cell-mediated immune responses: 1. Cytotoxicity, 2. Th cell-mediated macrophage activation (Delayed type hypersensitivity=DTH)
	22	Effector mechanisms of cell-mediated immune responses (NKT, MAIT)
18-Nov	23	Systemic and local immunity (SALT, MALT).
	24	Suppression of the immune response.
25-Nov	25	Overview of Basic immunological methods: Principles of serological methods - agglutination, precipitation
	26	Overview of Basic immunological methods: ELISA, ELISpot, dot blot and Western blot methodologies
2-Dec	27	Overview of Basic immunological methods: Immunohistology, immunofluorescence techniques, and multiplex immunoassays
	28	Overview of Basic immunological methods: Flow cytometry and cell separation procedures

Basic terms

- **Immunis,- e** (*Julius Caesar*) = exempt, free of burden (E.g. tax, law, or diseases)
- **IMMUNE:** individuals who do not capitulate to a disease when infected;
- **IMMUNITY:** status of **specific** resistance to a disease;
- **IMMUNOLOGY:** branch of theoretical biology focuses on mechanisms responsible for **both self and non-self recognition, elimination of the invaders and protection of the basic structural elements.**

Definition of the antigen

Detre (Deutsch) László (1874-1939):

ANTIBODY **GEN**ERATOR: foreign substance induces antibody production (1899)

Modern definition: substance, which is recognized by T cell and/or B cell receptors, and it is able to induce ***active immune response or tolerance*** according to the host immunogenetic background (MHC haplotype).

Main tasks of the immune system

The immune system is dynamic structural and functional network.

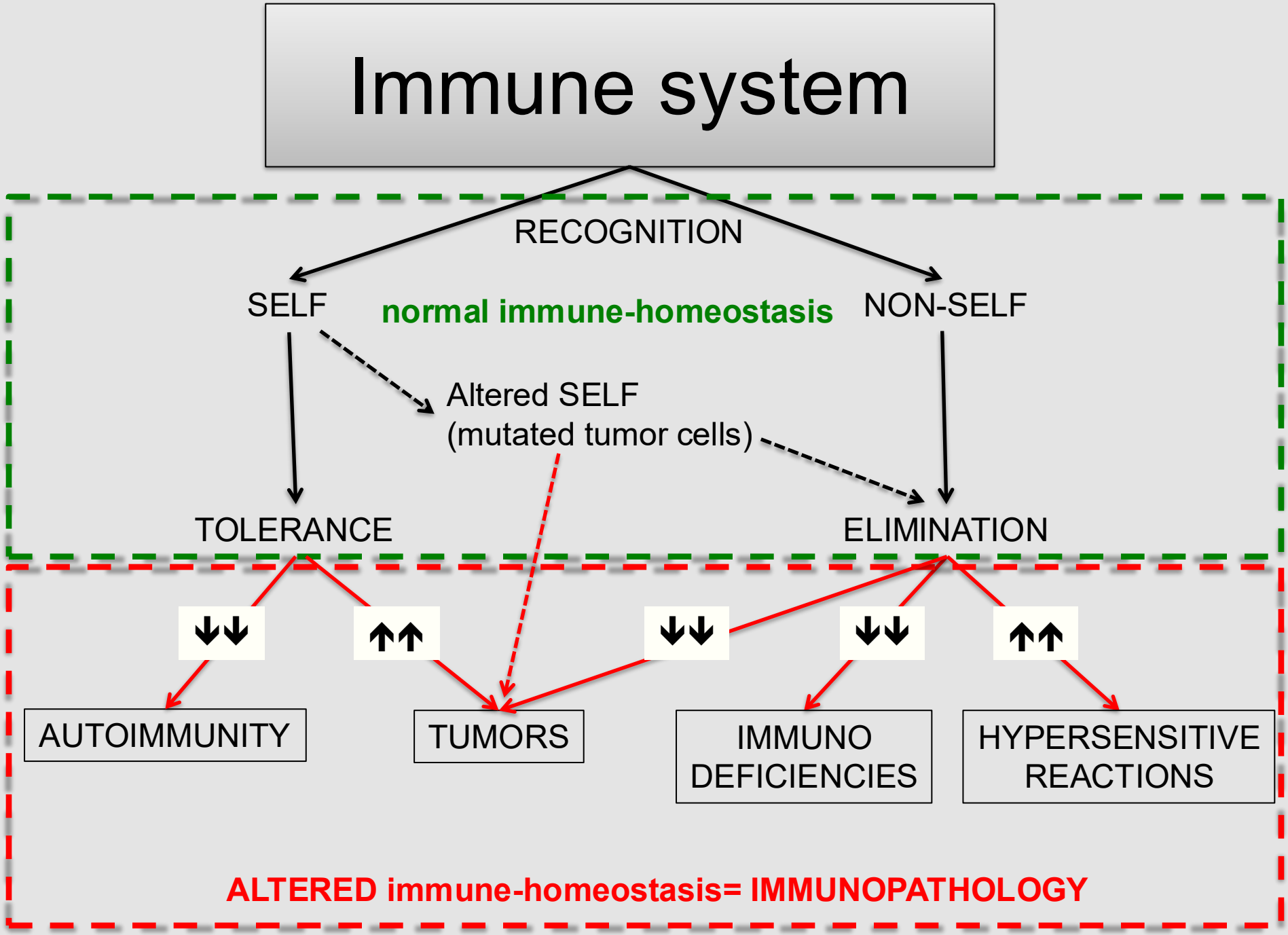
Preserving the integrity of an organism

Defense against **external pathogens** (e.g. viruses, bacteria, parasites)

Elimination of one's **pathologically altered cells** (e.g. virally infected cells, cancer cells)

Altered self- and foreign structures must be **recognized** and **distinguished** from the organism's own healthy cells.

IMMUNE RESPONSE (either an aggressive response or immunological tolerance)


Immune system
RECOGNITION
SELF
normal immune-homeostasis
NON-SELF
Altered SELF
(mutated tumor cells)
TOLERANCE
ELIMINATION
AUTOIMMUNITY
TUMORS
IMMUNO DEFICIENCIES
HYPERSENSITIVE REACTIONS
ALTERED immune-homeostasis= IMMUNOPATHOLOGY

Organs of the immune system

- The immune system is organized into a **network** of cells and organs. (the entire body must be protected from pathogens)
- Lymphoid organs:
  - **Primary** (production of immune cells)
    - **Bone marrow, thymus**, embryonic liver (+bursa of Fabricius in birds [nomenclature: „B" lymphocytes originating from the bursa and „T" cells from the thymus[1.]])
  - **Secondary** (site of antigen recognition, immune response)
    - **Lymph nodes, spleen, MALT** (mucosa-associated lymphatic tissue), **SALT** (skin-associated lymphatic tissue)
  - **Tertiary** (pathological, usually due to chronic inflammation)
    - E.g. ectopic (=at an abnormal site) lymphoid follicles

Composition of the immune system

Innate

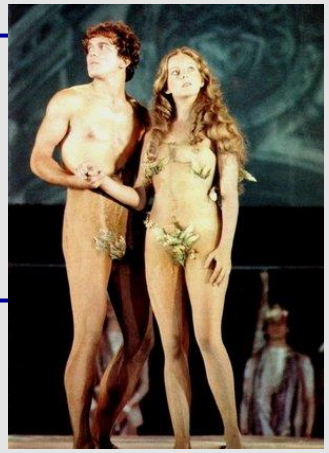
- None antigen specific
- No immunological memory
- Rapid reactivity
- Linear amplification of the reaction

Adaptive

- Antigen specific
- Immunological memory
- Activated after a latency
- Exponential amplification of the reaction

Natural

Innate-like immunity with adaptive features



Innate immune system

- **Pattern recognition receptors** (PRR)
- **Pathogen associated molecular patterns** (PAMP)
- **First line defence**
- **Low number of molecularly distinct receptors and high number of recognized patterns**
- **Main molecular components:** Antibacterial peptides, Complement factors and their receptors, Heat shock proteins, Fc receptors, Inflammatory cytokines, Growth factors, Histamine
- **Main cellular components:** Macrophages, Monocytes, NK cells, Granulocytes, Mast cells

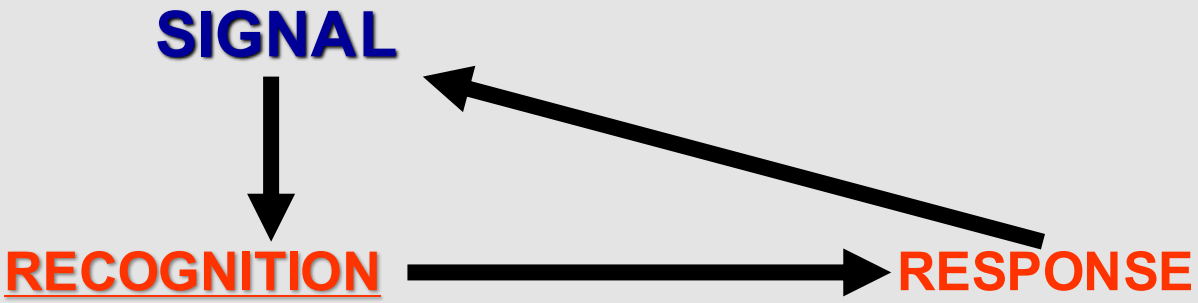
Adaptive immune system

- Antigen receptor (BCR,TCR)
- Epitope specific in a given antigen
- Adaptive immune response
- High number of distinct antigen receptors and high number of recognized antigens
- Main molcelar components: Antibodies, MHC, T and B cell receptors, Lymphatic citokines
- Main cellular components: αβT cells, B2 cells, Antigen presenting cells

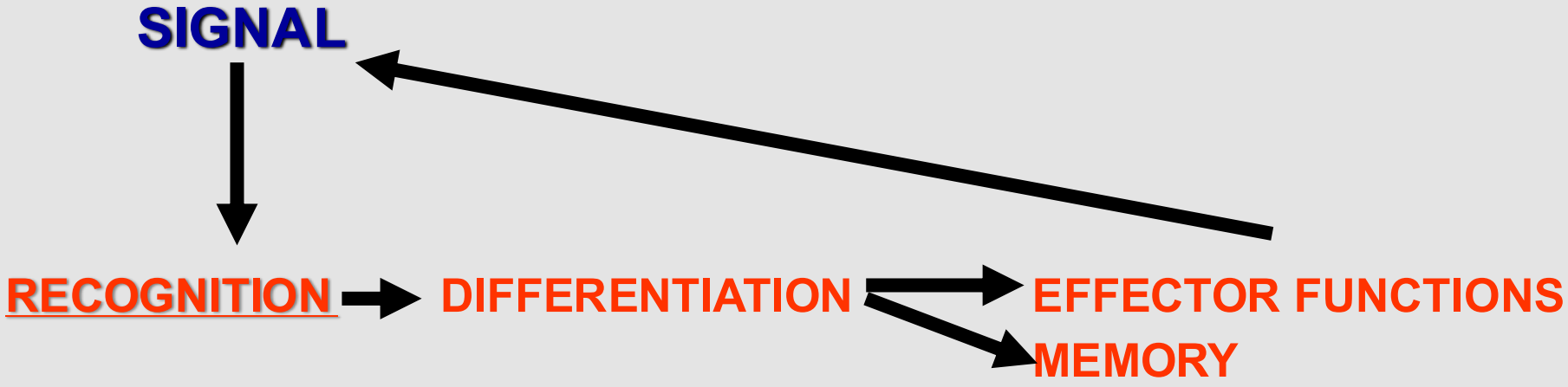
Natural immune system

- Antigen recognition receptors (BCR,TCR) with limited specificity
- Patern recognition profile
- Innate-like immune response
- Limited number of distinct antigen receptors and high number of recognized antigens
- Main cellular components: iNKT cells, iγδT cells, MAIT cells, IEL cells, CD5+ B1 cells
- Main molcelar components: natural (auto)antibodies

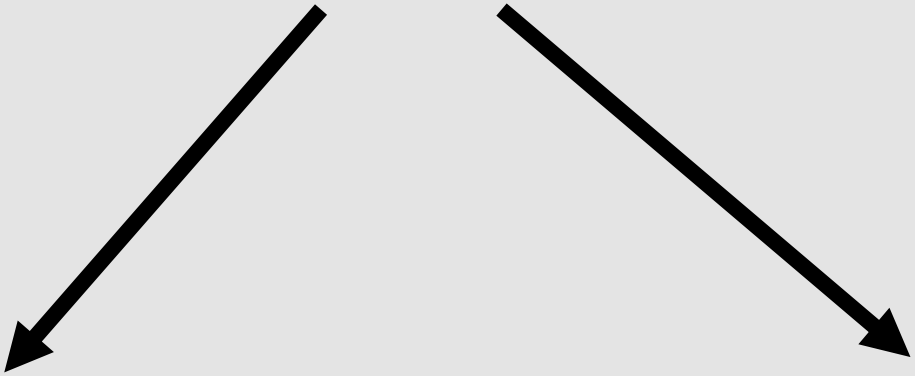
Theoretical scheme of the innate immunity



Theoretical scheme of the adaptive immunity



Immunological Recognition (Receptors)



Innate immunity

general microbial
Molecular PATTERNs

(„pattern recognition receptors”)

Adaptive immunity

Antigenspecific (EPITOP)

Recognition molecules

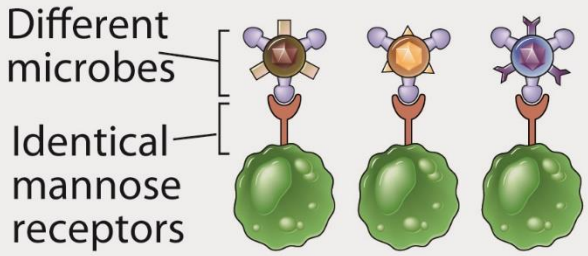
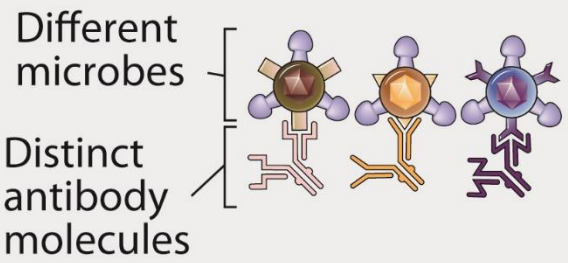
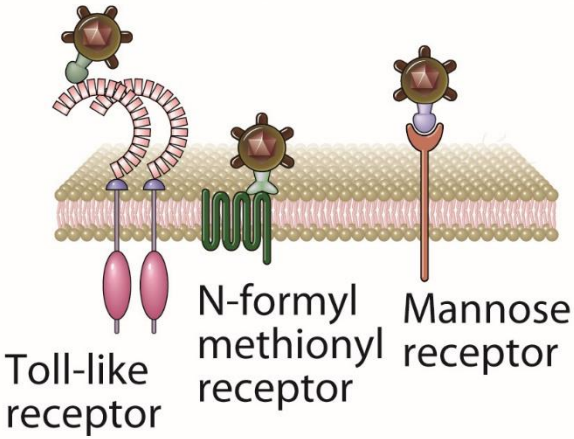
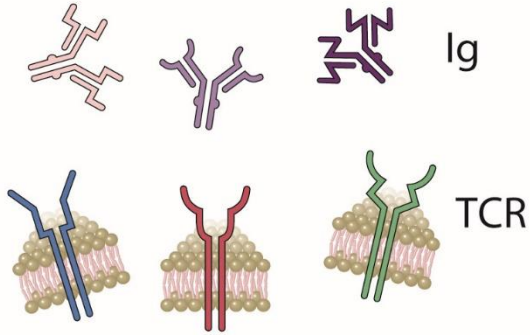
	Innate immunity	Adaptive immunity
Specificity	**For pathogen-associated molecular patterns (PAMPS)** 	**For structural details of any molecules (antigens)** 
Receptors	**Encoded in germline (pattern recognition receptors)** 	**Encoded by lymphocyte genes produced by somatic recombination** 
Distribution of receptors	**Non-clonal**	**Clonal**

Table 4-1