

8. Towards an integrated view of the immune system

by Bruno Lemaitre,
Ecole Polytechnique Fédérale de Lausanne

Web: <http://ghi.epfl.ch>

Humoral and cellular immunity

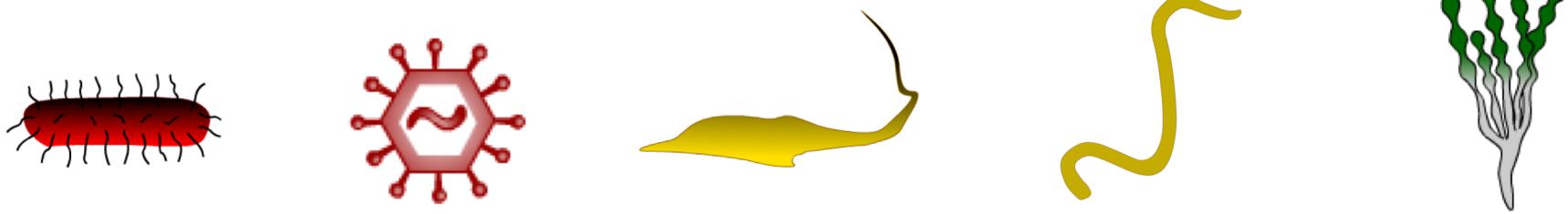
Cellular and humoral branches of the immune system play different roles in protecting the host:

	Humoral immunity	Cell-mediated immunity
Directed against	extracellular pathogens	intracellular pathogens or “altered” self (e.g. tumors)
Effector mechanisms	antibodies	<ul style="list-style-type: none">• antigen-specific cells (CD4+ Th cells and CD8+ CTLs)• non-specific cells (NK cells, macrophages, neutrophils, eosinophils)• cytokines that support cell-mediated immunity

Interplay between cellular and humoral immunity

- Interplay between humoral and non-specific cellular immunity:
 - Fc receptors (FcR) on NK cells, macrophages and neutrophils bind to antibody-coated pathogens for destruction
- Interplay between humoral and specific cellular immunity:
 - Th cells interact with B cells to promote antibody isotype switch (T/B collaboration)
- Interplay between specific and non-specific cellular immunity:
 - cytokines secreted by either arm of immunity influence the other arm
 - macrophages and dendritic cells are APCs for specific T cells

Classes of disease-causing agents



Bacteria	Viruses	Protozoans	Worms	Fungi
<i>Salmonella</i>	HIV (AIDS)	<i>Plasmodium</i> (Malaria)	<i>Schistosoma</i> (dermatitis, hepato-, splenomegaly)	Dermatophytes (cutaneous mycosis)
<i>Shigella</i> (dysentery)	<i>Influenza</i> (Flu)	<i>Leishmania</i> (cutaneous lesions)	<i>Tenia</i> (asymptomatic)	Saprophytes (subcutaneous mycosis)
<i>Staphylococcus aureus</i>	HAV, HBV (Hepatitis)	<i>Trypanosoma</i> (sleeping sickness, Chagas disease)		
<i>Pneumococcus</i> (otitis, pneumonia)	<i>Rotavirus</i> (diarrhea)	<i>Toxoplasma gondii</i> (fetal abnormalities)		
		<i>Entamoeba histolytica</i> (dysentery)		
		<i>Cryptosporidium parvum</i> (diarrhea)		

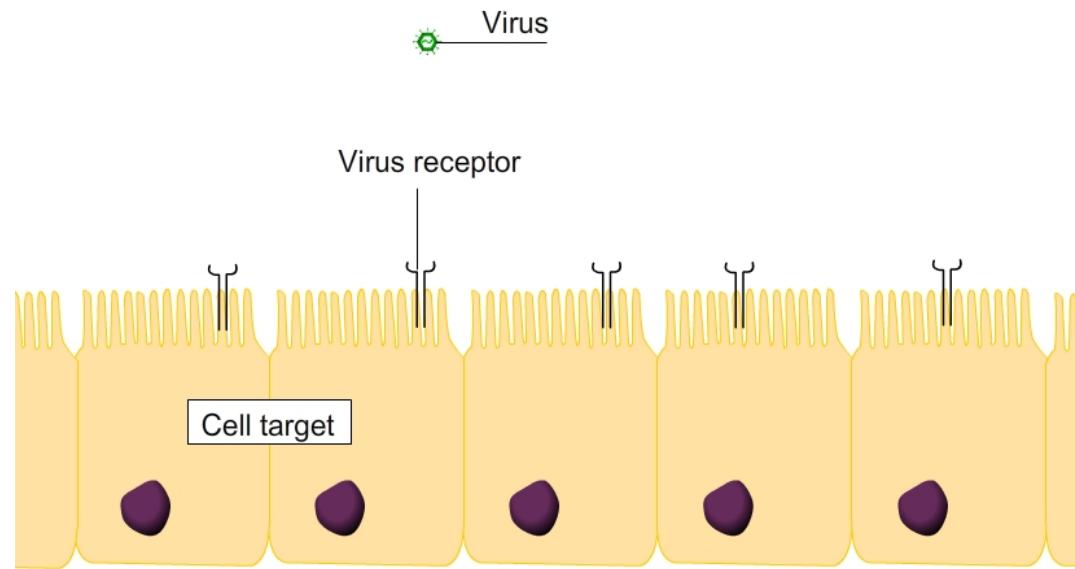
Different types of adaptive immune responses

	Humoral immunity	Cell-mediated immunity	
Typical pathogens	<i>Clostridium</i> <i>Staph. aureus</i> <i>Strep. pneumoniae</i> Polio <i>Pneumocystis</i> <i>Trichinella</i>	Vaccinia Influenza Rabies <i>Listeria</i>	<i>Mycobacteria</i> <i>Leishmania</i> <i>Pneumocystis</i>
Location	Extracellular fluid	Cytosol	Macrophage vesicles
Effector T cells	Th1 and Th2 cells	Cytotoxic CD8 T cells	Th1 cells
Antigen recognition	Peptide-MHC class I complex on antigen-specific B cell	Peptide: MHC class I complex on infected cell	Peptide: MHC class I complex on infected macrophage
Effector action	Activate specific B cells to produce antibodies	Kill infected cell	Activate infected macrophages

Defence against microbes

Viral infection	Bacterial infection		Parasitic infection	
Cytopathogenic	Non- cytopathogenic	Extracellular	Intracellular	Protozoan
Antibodies	CTL	Antibodies	Antibodies + CTL	IgE antibodies

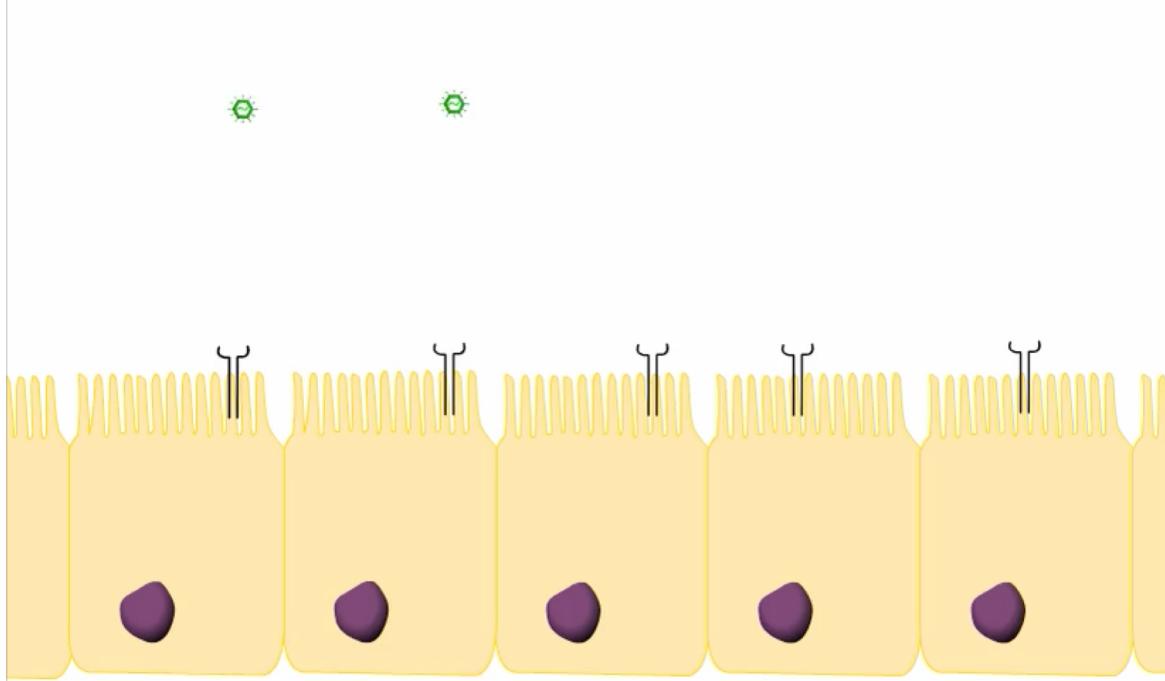
Cytopathogenic Virus



Defence against microbes

Viral infection		Bacterial infection		Parasitic infection	
Cytopathogenic	Non- cytopathogenic	Extracellular	Intracellular	Protozoan	Helminths
Antibodies	CTL	Antibodies	Antibodies + CTL	Antibodies + CTL	IgE antibodies

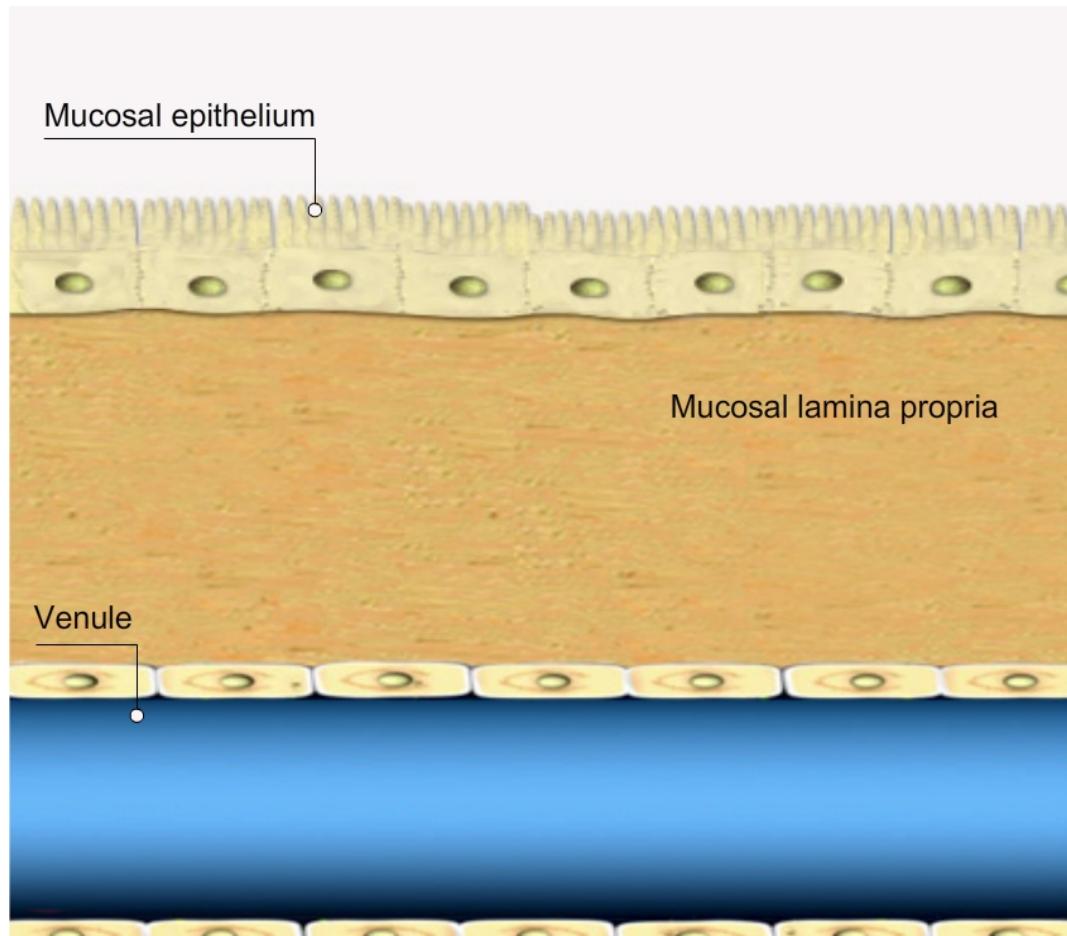
Non-cytopathogenic
Virus



Defence against microbes

Viral infection		Bacterial infection		Parasitic infection	
Cytopathogenic	Non- cytopathogenic	Extracellular	Intracellular	Protozoan	Helminths
Antibodies	CTL	Antibodies	Antibodies + CTL	Antibodies + CTL	IgE antibodies

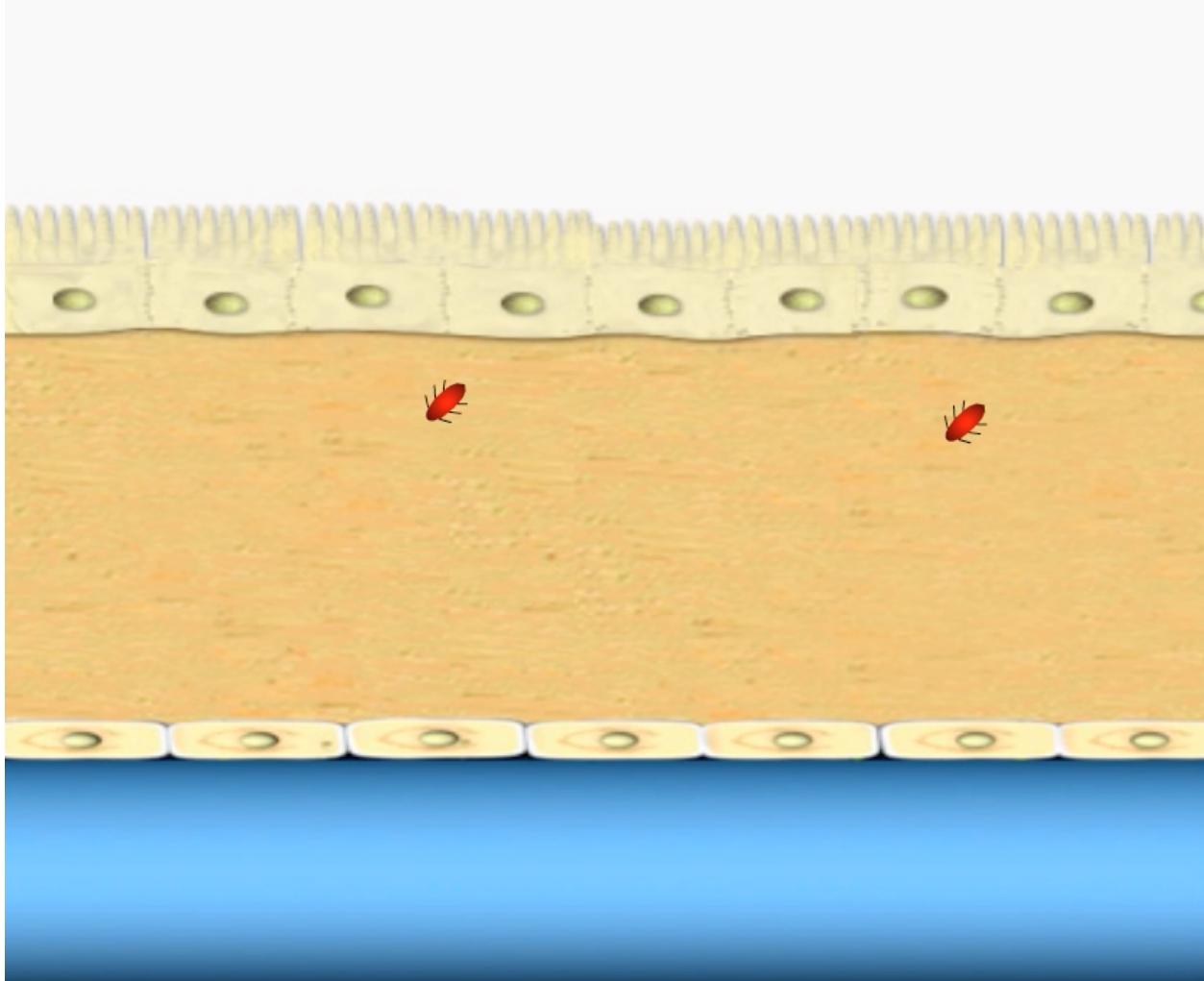
Neutralization



Defence against microbes

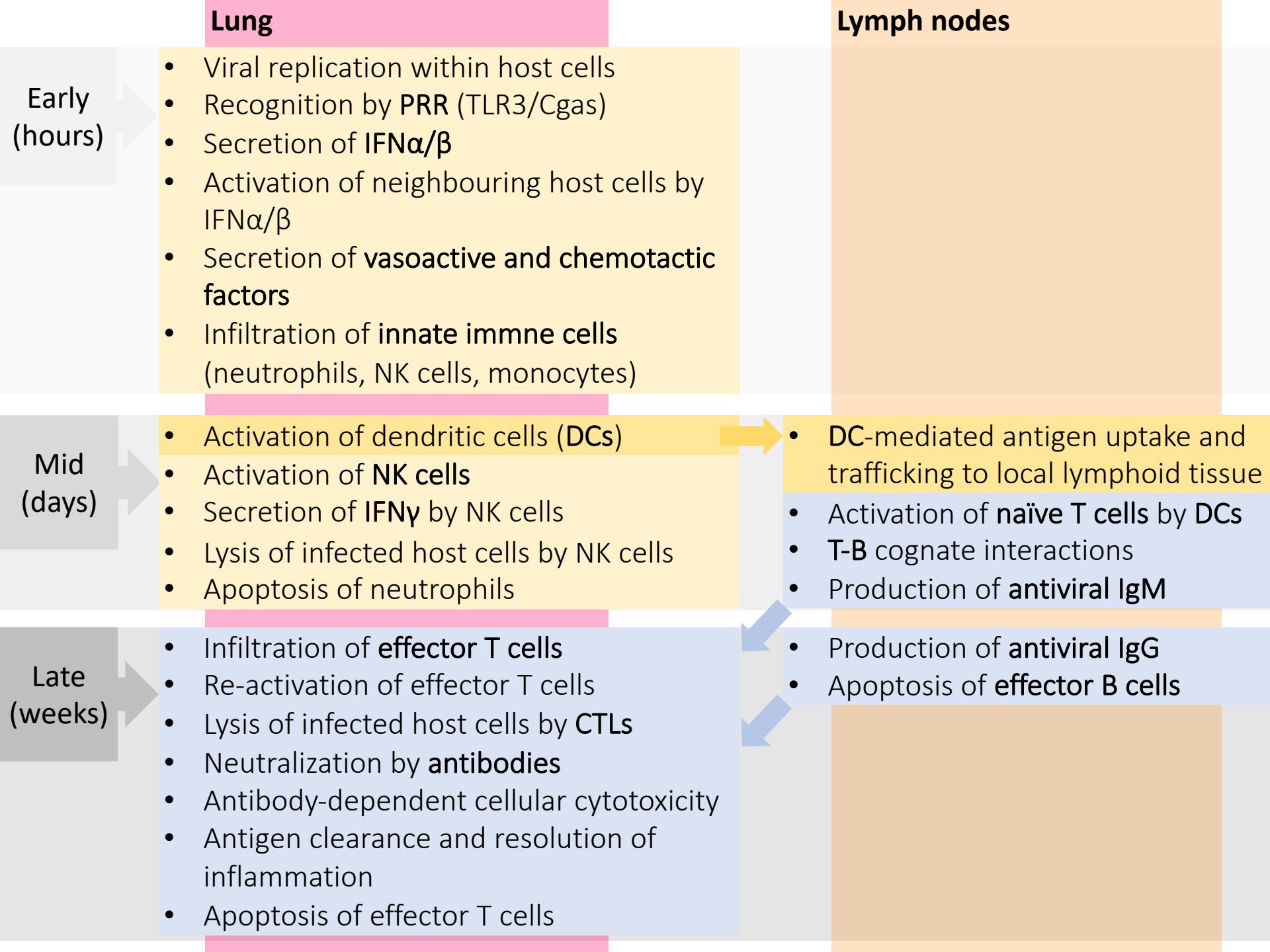
Viral infection		Bacterial infection		Parasitic infection	
Cytopathogenic	Non- cytopathogenic	Extracellular	Intracellular	Protozoan	Helminths
Antibodies	CTL	Antibodies	Antibodies + CTL	Antibodies + CTL	IgE antibodies

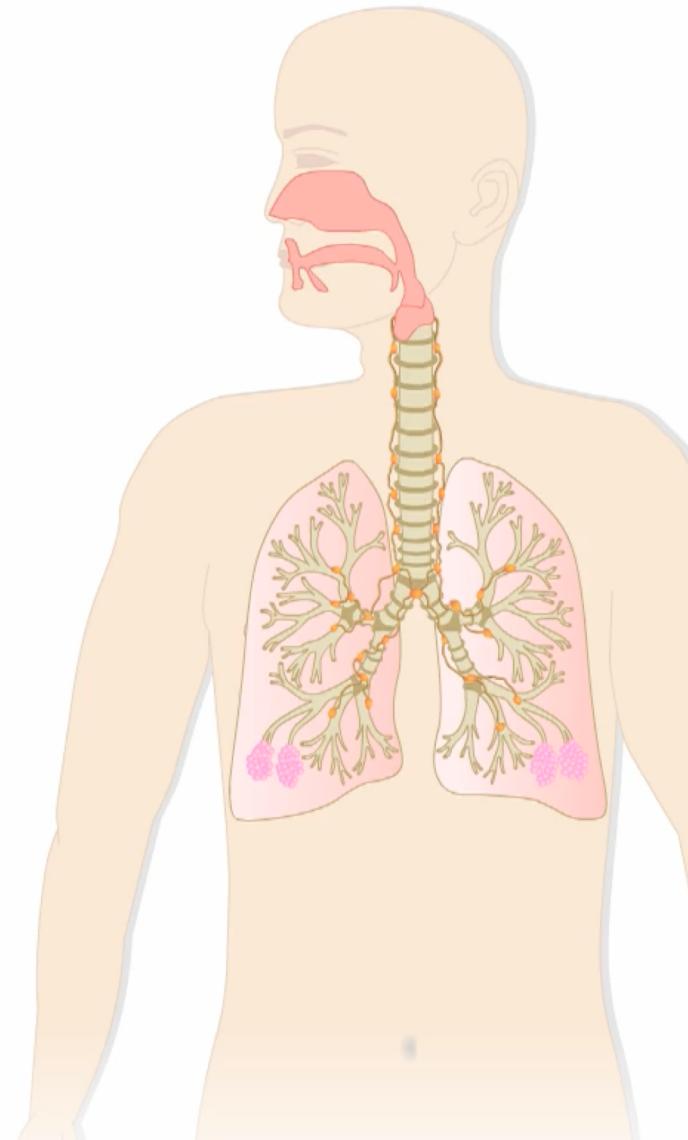
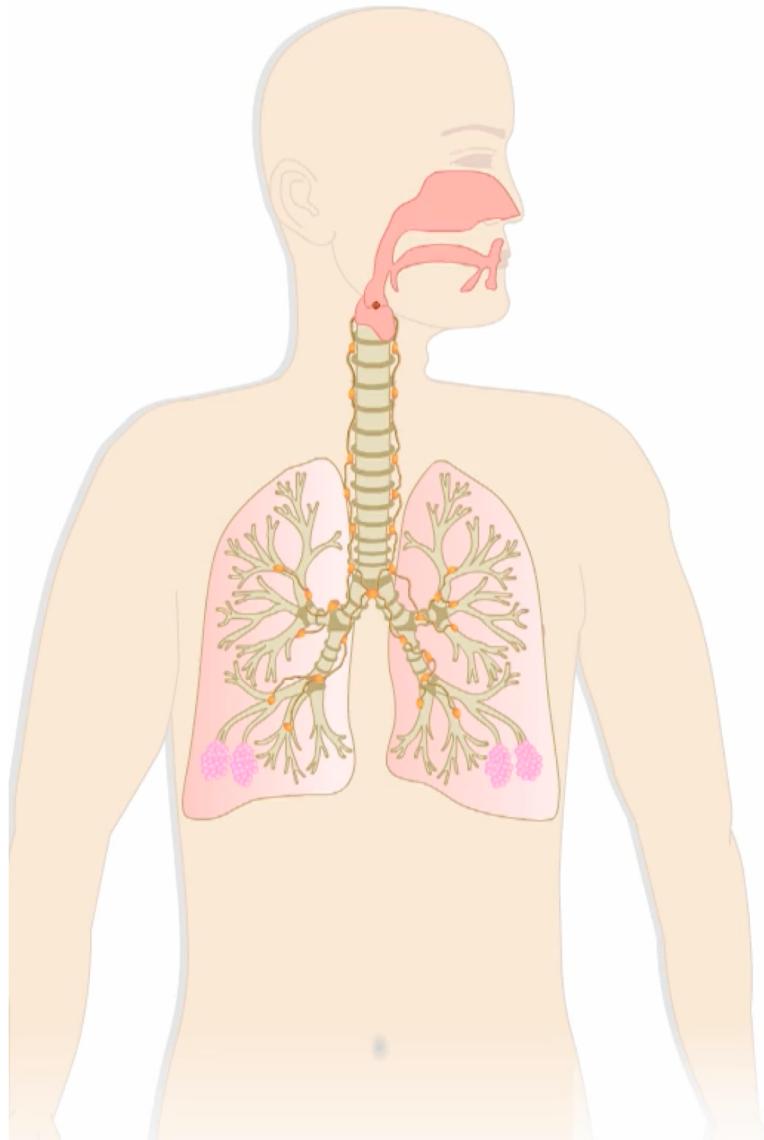
Phagocytosis



An integrated view of the immune system

Example: infection by a respiratory virus





Hot Topics in Immunology Research

- Immuno-metabolism
- Ontogeny of the immune system
- Immuno-aging
- Evolution of the immune system
- Mucosal immunology - Microbiota
- Inflammation and diseases (metabolic, neurodegeneration)
- Imaging of the immune system
- Central and peripheral haematopoiesis
- Immunity to infection
- Immunology and human populations
- Immunotherapy