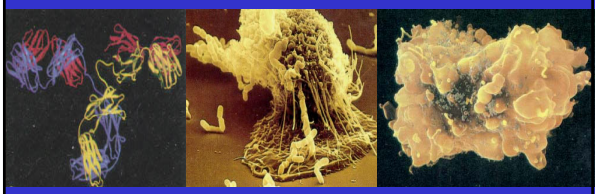
NURSING

Science lectures



Prof Peter O'Donoghue

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LEARNING OBJECTIVES

Lecture 8: Overview of Defense (Immunology)

- identify cells and tissues of the immune system
- recognize innate immune responses (barriers/inflammation)
- review acquired immune responses (humoral/cell-mediated)

protection and pathology

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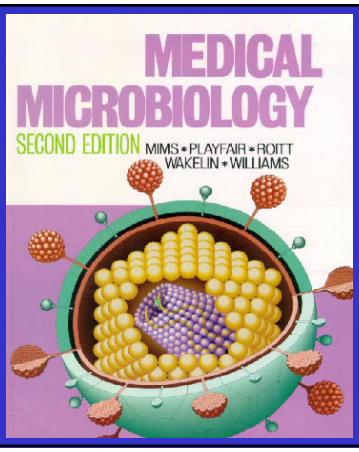

Second edition
1999
Third edition
2004

Chapters 4-6

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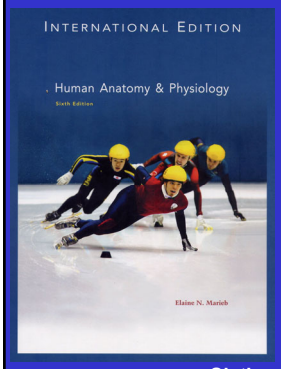
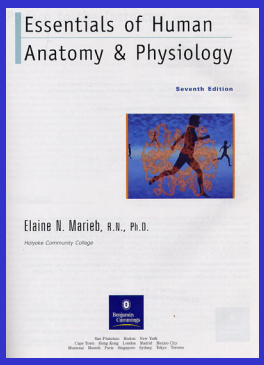
Textbooks





Sixth edition, 2004
Chapters 20-21

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ROLE OF IMMUNE SYSTEM IN HEALTH AND DISEASE

AGENT	NORMAL response	DEFICIENT response
infectious organism	protection	persistent/recurrent infection
tumour	immunity	cancer
grafted organ/tissue	rejection	acceptance
innocuous substance	allergy	no response

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IMMUNE SYSTEM

Structures	Function
• organs (bone marrow, thymus, spleen)	factory
• tissues (lymphatic system)	transit system
• cells (phagocytes, lymphocytes)	effectors
• molecules (cytokines, lymphokines)	signals

All function to provide:

- nonspecific immunity (innate) => no memory
- specific immunity (adaptive/acquired) => memory

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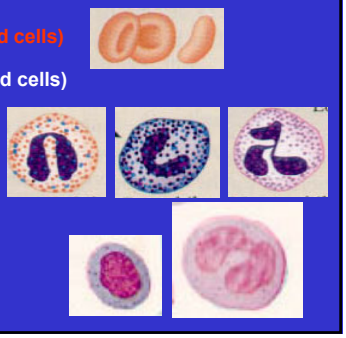
BLOOD CELLS

circulating cells divided into:

- erythrocytes (red blood cells)
- leucocytes (white blood cells)
  - granular
    - eosinophils
    - basophils
    - neutrophils
  - agranular
    - lymphocytes
    - monocytes



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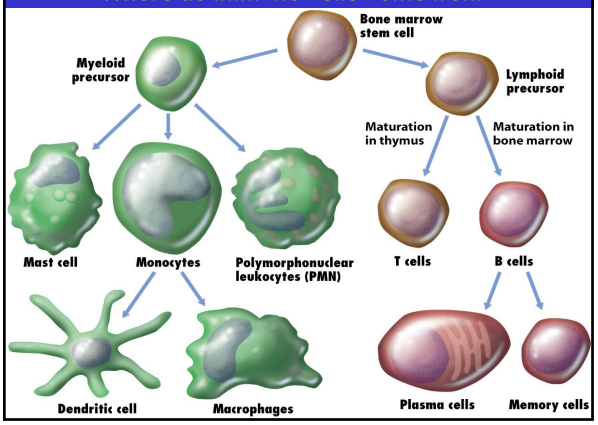
Where do immune cells come from?



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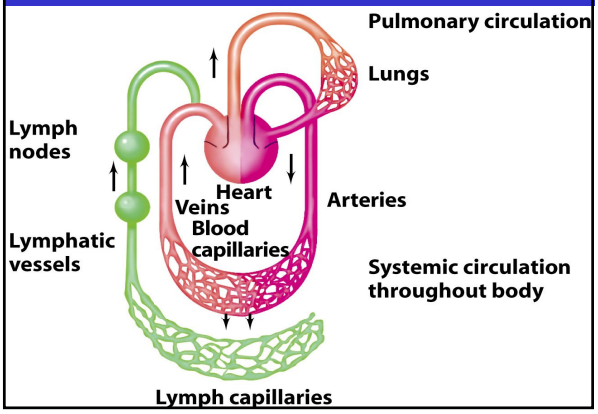
LYMPHATIC SYSTEM



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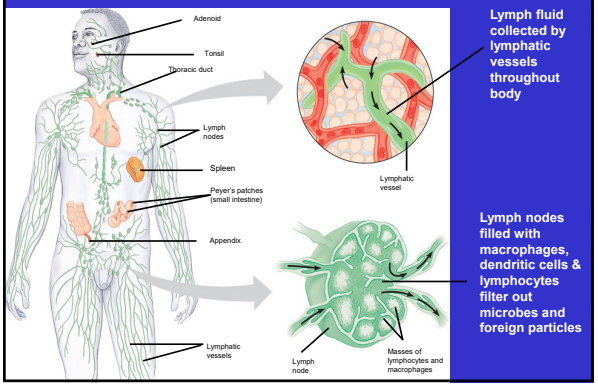
Lymphatic filtration system



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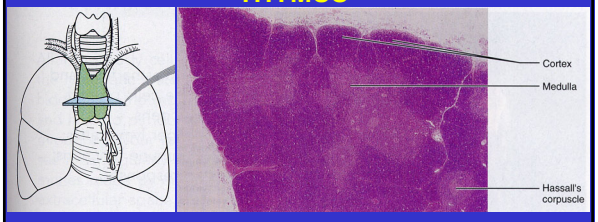
Lymph organ
THYMUS



- bilobed organ
- in inferior neck
- lobules & corpuscles

- causes lymphocytes (T cells) to become immunocompetent
- secretes hormones (thymosin & thymopoietin)

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THREE LINES OF IMMUNE DEFENSE

first line BARRIER	second line INNATE	third line ADAPTIVE (ACQUIRED)
external coverings & secretions	phagocytes & inflammation	cell-mediated & humoral responses
nonspecific	nonspecific	specific

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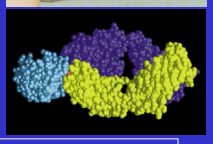
first line of defense

NONSPECIFIC EXTERNAL BARRIERS

PHYSICAL (coverings)
- intact skin
- mucous membranes
- cilia in respiratory tract
- flow through tubular organs

CHEMICAL (secretions)
- mucus, sweat, lysozyme
- saliva, gastric juices
- urine
- milk



objective is to prevent entry of pathogens

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second line of defense

NONSPECIFIC INNATE IMMUNITY

phagocytes	- ingest pathogens
natural killer cells	- lyse infected cells
antimicrobial proteins complement (C') interferon (IFN)	 - lyse microbes - inhibit viral spread
inflammation	- deliver phagocytes to injured tissues

objective is to mop up microbes that have entered

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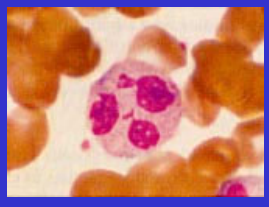
PHAGOCYTES

tissue macrophages

fixed or migratory
long-lived

circulating neutrophils



60-70% of leucocytes
short-lived

chemotaxis - chemokines attract phagocytes

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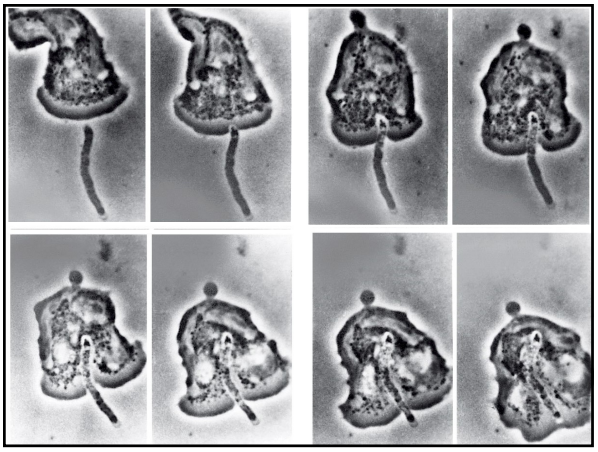

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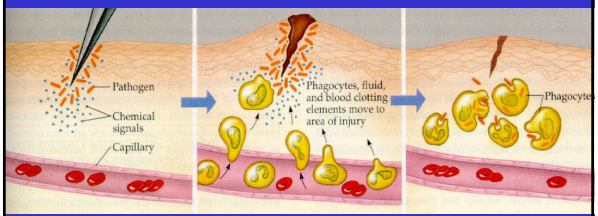
INFLAMMATION

"setting on fire" = rubor (redness), calor (heat), tumor (swelling), dolor (pain)



tissue injury
release of chemical signals

dilation and increased permeability of blood vessels

phagocytosis of pathogens

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third line of defense

SPECIFIC ADAPTIVE (ACQUIRED) IMMUNITY

reliant on lymphocytes

provide specificity, diversity, memory, self tolerance

develop from pluripotent stem cells in bone marrow

T cells	B cells
mature in thymus	mature in marrow
cell-mediated immunity	humoral immunity

objective is to target and destroy "nonself"

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Triggered by exposure to ANTIGENS

Molecules provoking immune responses
(non-self = foreign)

Complete antigens
- large molecules
  (proteins, nucleic acids, lipids, polysaccharides)
- reactive by themselves
- immunogenic (antibody generating)

Incomplete antigens (haptens)
- small molecules (peptides, nucleotides)
- only reactive when linked with other proteins
- not immunogenic (not protective)

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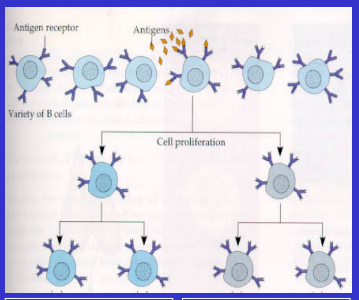
Having been activated,
the lymphocytes grow and proliferate
- process known as clonal selection



Two types of clones formed: short-lived effector cells | long-lived memory cells

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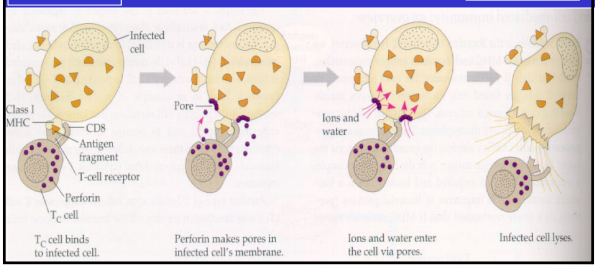
CELL-MEDIATED IMMUNITY

Cytotoxic T cells

antigen | perforin

infected cell | cell lysis



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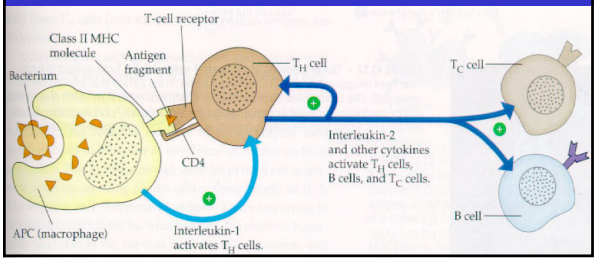
CELL-MEDIATED IMMUNITY

Helper T cells

antigen | cytokines

APC (mϕ) | effector cells



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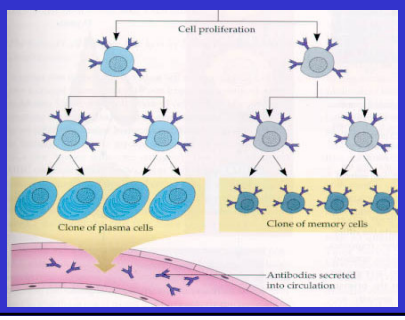
HUMORAL IMMUNITY

B cells

PLASMA CELLS (secrete antibodies) | MEMORY CELLS (ready for next challenge)



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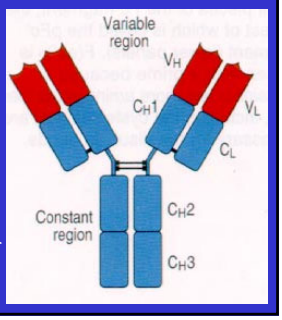
ANTIBODY

= immunoglobulin = gamma-globulin
5 classes (IgG, IgM, IgA, IgD, IgE)

Y-shaped glycoproteins

- Fab = antigen-binding
- Fc = constant (opsonization)



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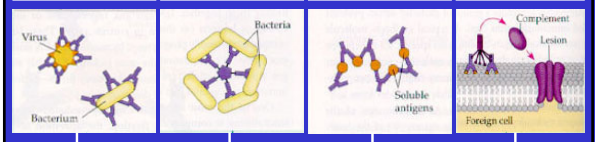
ANTIBODY ACTION

neutralization	agglutination	precipitation	C' fixation



phagocytosis

cell lysis

opsonization

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RECAP

IMMUNITY

- barrier (nonspecific) - physical
  - chemical
- innate (nonspecific) - phagocytosis
  - inflammation
- adaptive (specific) - humoral (B cells) - antibodies
  - cell-mediated (T cells) - helper
    - cytotoxic

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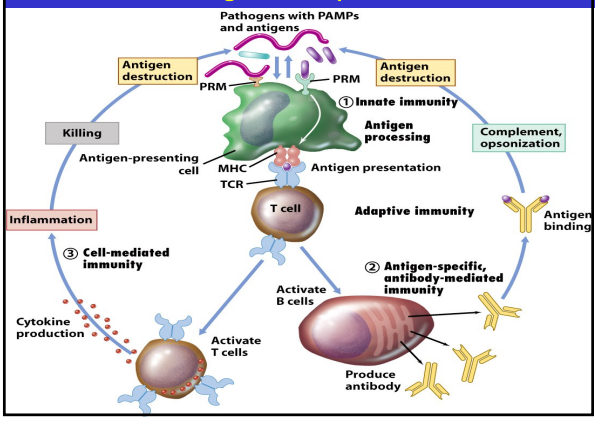
Integrated responses



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What happens if it all goes wrong?

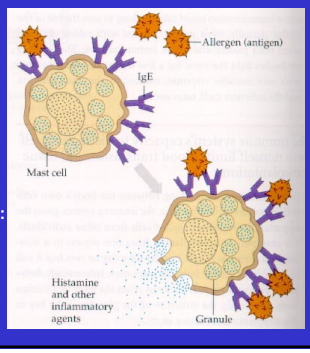
e.g. ALLERGIES (inappropriate/exaggerated responses)

first exposure:

sensitization

second exposure:

hypersensitivity



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FOUR TYPES OF HYPERSENSITIVITY

type I	immediate (minutes)	allergens	anaphylaxis asthma, hives	IgE, mast cells
type II	cytotoxic (hours)	Ab-dep	haemolytic anaemia	IgG, IgM, C'
type III	immune complex (hours)	Ag-Ab deposits	serum sickness	IgG, Ag, C'
type IV	delayed type (days)	skin reactions	contact dermatitis	T cells, mØ

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IMMUNE SYSTEM PROBLEMS

autoimmune diseases	- auto-antibodies (SLE, RA) - T cell intolerance (MS, diabetes)
immunodeficiencies	- congenital (SCID) - acquired (HIV-AIDS) - pathological (Hodgkins cancer)
immunosuppression	- chemotherapy (cancer treatment) - concomitant infections (measles)
incompatibility	- blood transfusion (groups) - tissue grafts (rejection) - organ transplantation (rejection)

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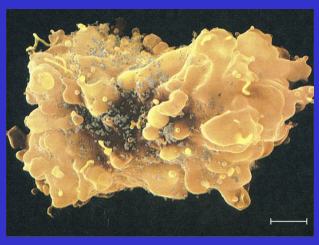
RA
rheumatoid arthritis

autoimmune disease
inflammation of joints

HIV
human immuno-deficiency virus



acquired immunodeficiency
loss of T_H cells

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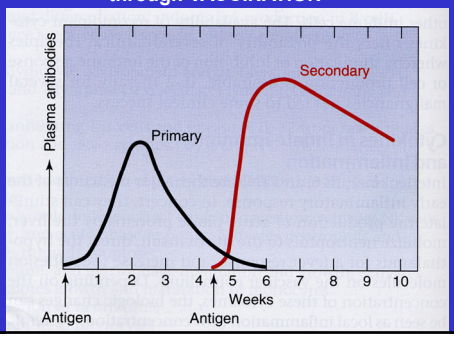
Can immune system be manipulated?

YES!
invoke/heighten immunological memory through VACCINATION



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VACCINATION

Jenner used cowpox (vaccinia) to protect against smallpox (variola)

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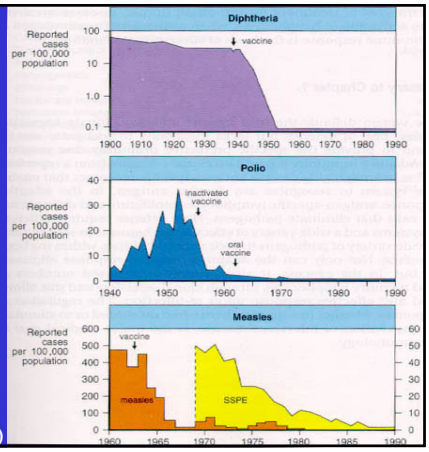
VACCINATION PROGRAMS

many success stories

BUT

still some antagonists

(you will meet them)



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Have you been vaccinated?

you are going to be dealing with some awfully sick people!!

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Nursing is multidisciplinary

- chemistry – atomic & molecular soup
- biochemistry – sugar-burning machines
- cell biology – membranes, organelles, DNA
- genetics - mitosis/meiosis, genes, heredity
- histology – epithelia/connective/muscle/nerve
- embryology – zygote, embryo, foetus
- microbiology – infectious diseases
- immunology - protection & defence

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