Basic Immunology

13th lecture:
Development of immunological memory
Comparison of the primary and secondary immune response

Ferenc Boldizsár MD, PhD

Immunological memory

- The ability to respond faster and stronger to repeated exposure to the same microbe
- Part of the adaptive immune response
- Relies on both T (CD4+ and CD8+) and B cells

1. Memory B cells

Development of memory B cells

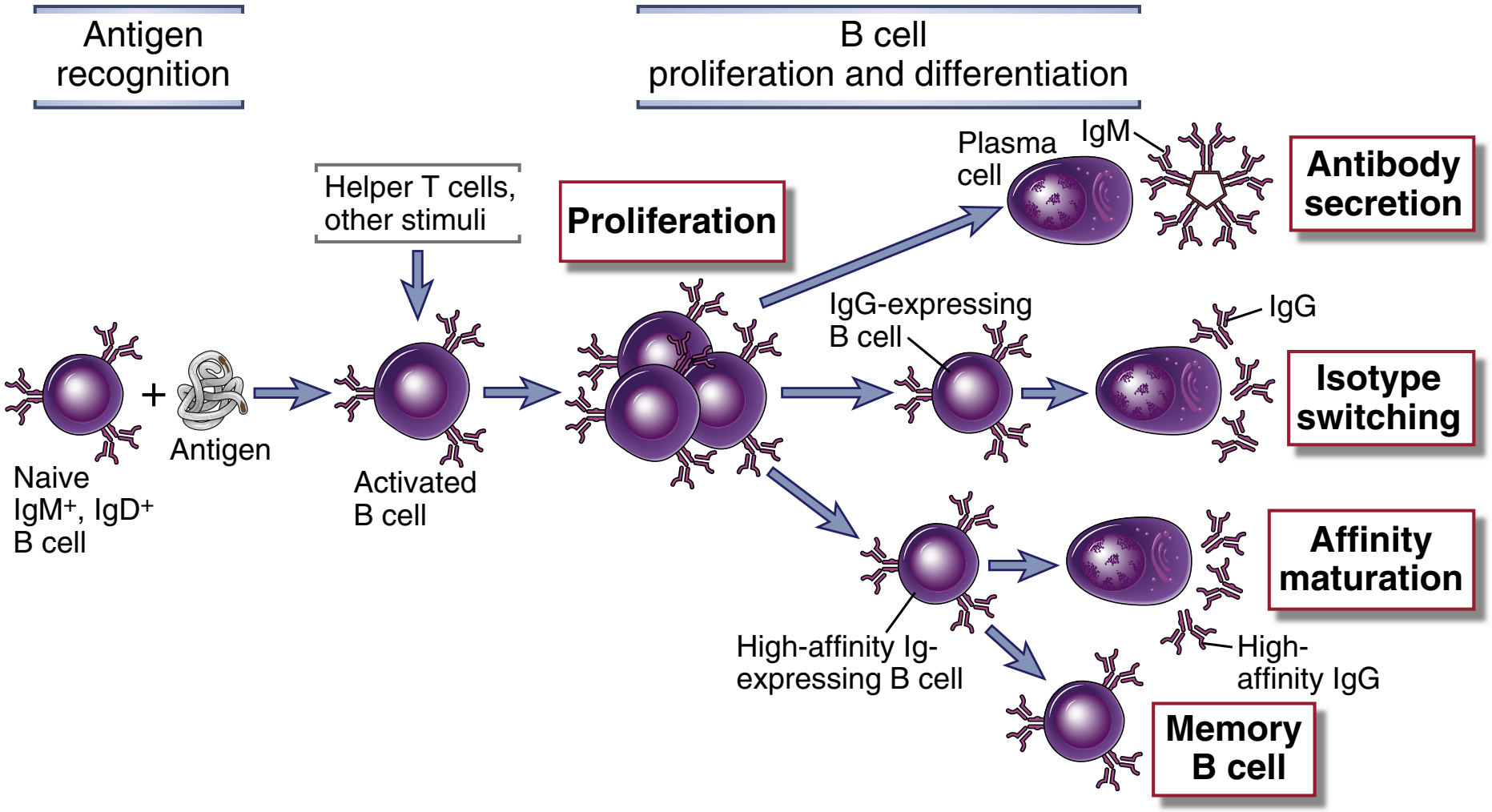


Fig 12-1

Primary and secondary antibody response

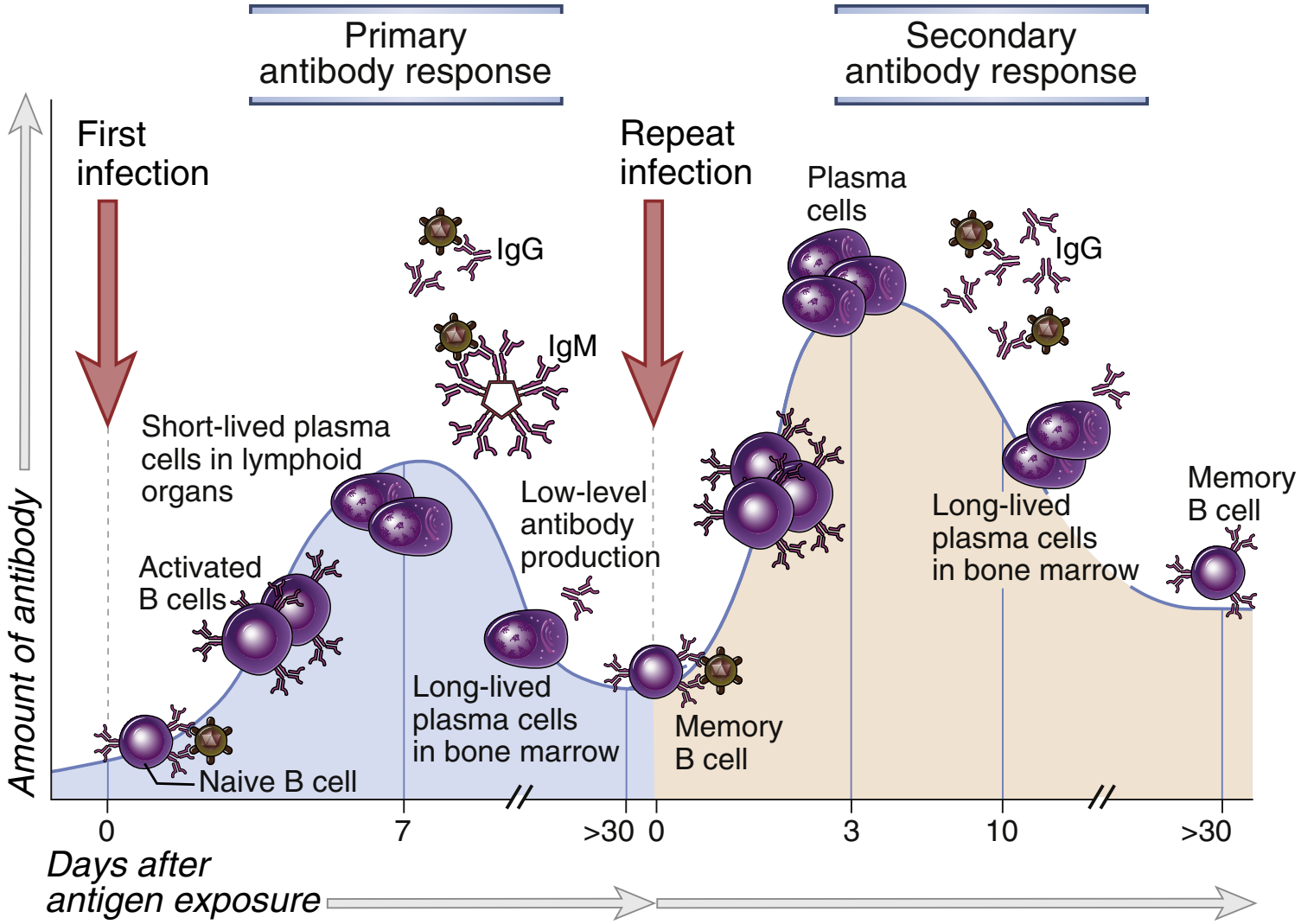


Fig 12-2

B cell memory is a T-dependent mechanism!!

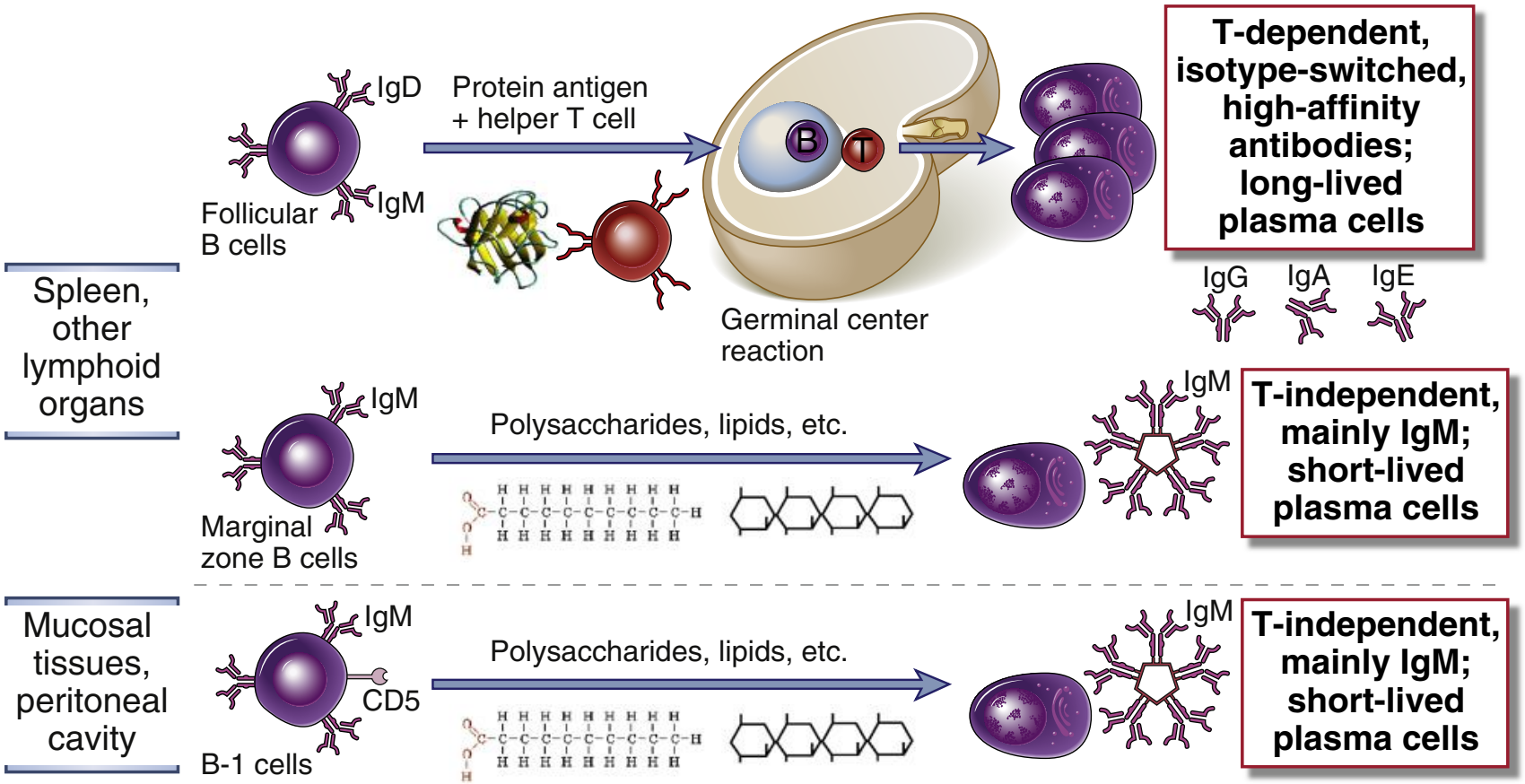


Fig 12-3

B cell memory is a T-dependent mechanism!!

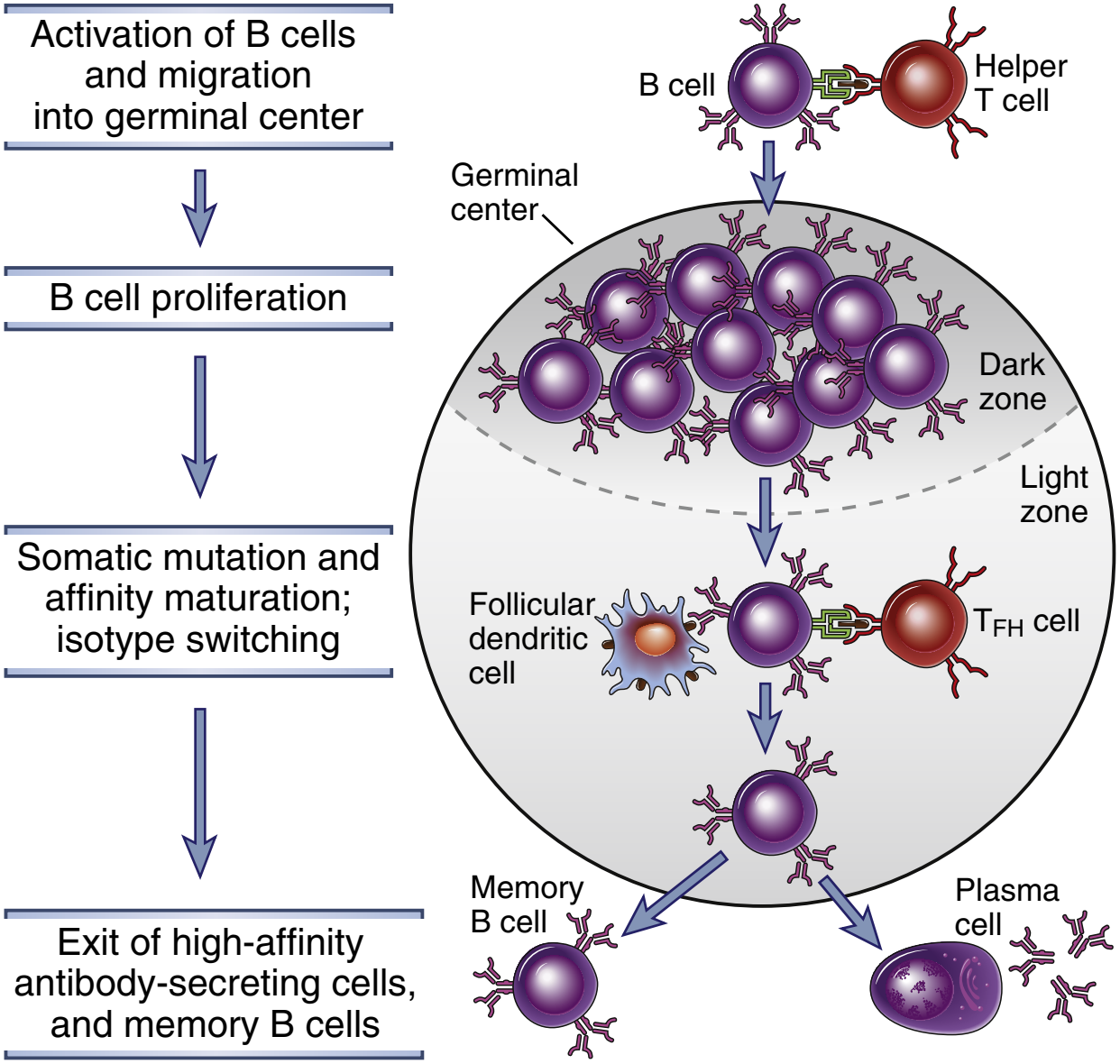


Fig 12-12

Comparison of the primary and secondary antibody response

	Primary response	Secondary response
Responding cell	Naive B cell	Memory cell
Frequency of antigen-specific cell	$1:10^4 – 1:10^5$	$1:10^3$
Isotype of secreted antibody	IgM>IgG	IgG, IgA, IgE
Latency period following activation	4-7 days	1-3 days
Affinity of antibody	low	high
Somatic hypermutation	low	high
Quantity of antibody	low	100-1000x higher
Recirculation	Secondary lymphoid tissues	Periphery
Complement receptor expression	low	high

2. Memory T cells

Development of memory T cells

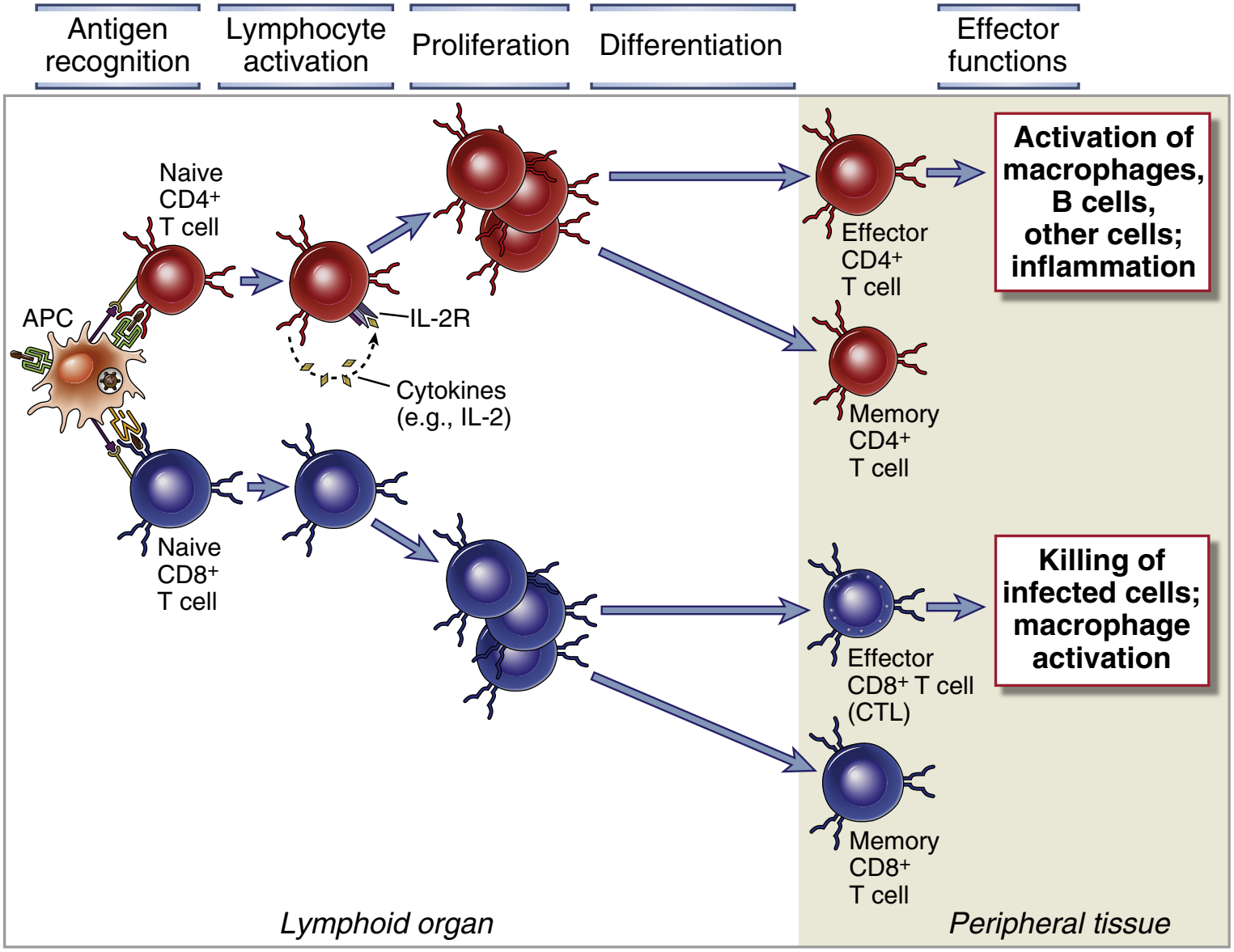


Fig 9-2

Memory T cells

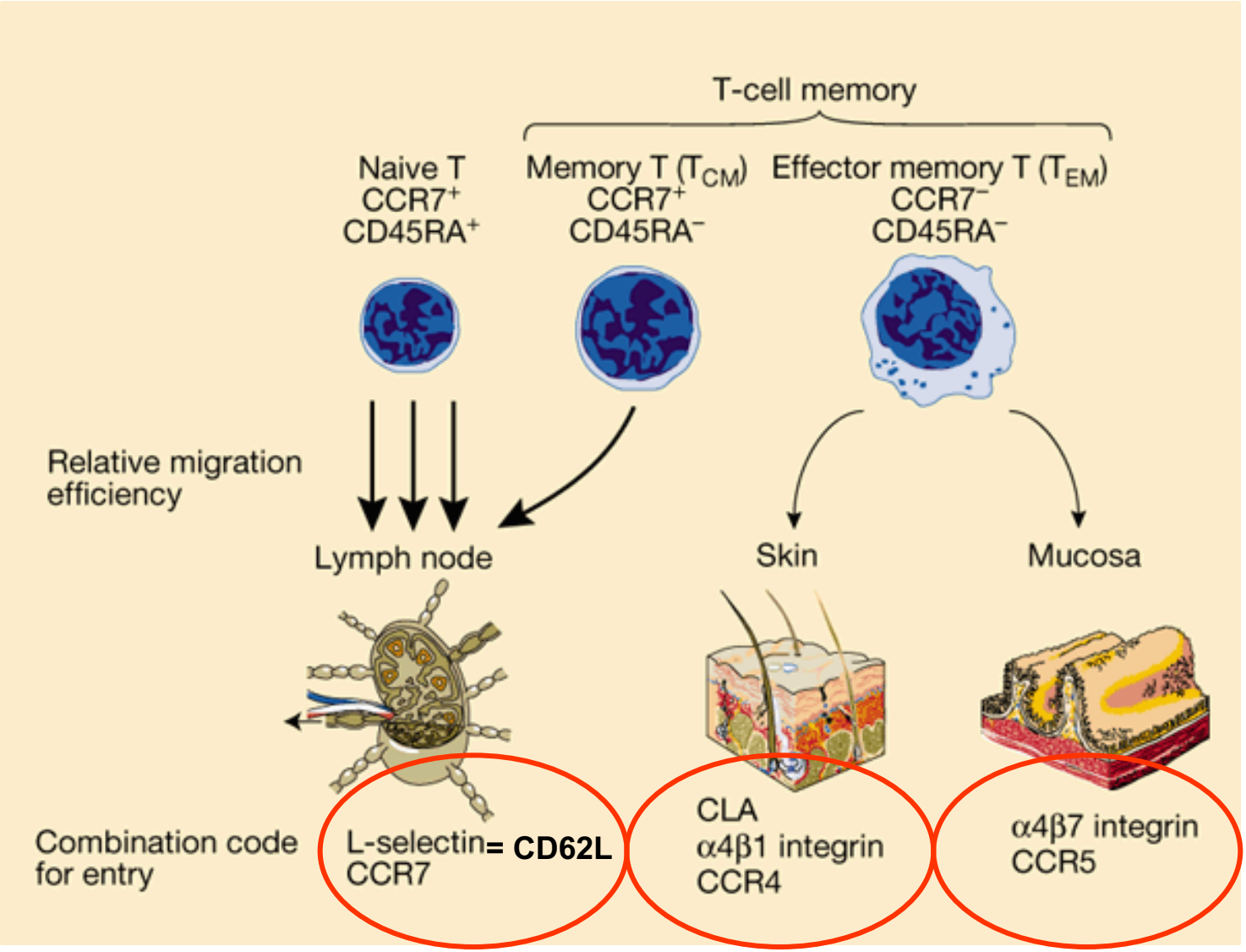
- Long-lived cells
- Survive in a quiescent state until re-encounter with antigen
- Enhanced ability to react with antigen
- Generate new effector cells upon encounter with antigen

Central and effector memory T cells

- Central memory T cells
  - $CD45RO^{+}$ $LselectinL^{hi}$ $CCR7^{hi}$
  - migrate to secondary lymphoid organs
  - rapid proliferation upon antigen challenge

- Effector memory T cells
  - $CD45RO^{+}$ $LselectinL^{lo}$ $CCR7^{lo}$
  - migrate to peripheral sites
  - rapid effector function upon antigen challenge

Central and effector memory T cells



Important characteristics of memory T cells

1. Clonal expansion: higher number of antigen-specific cells

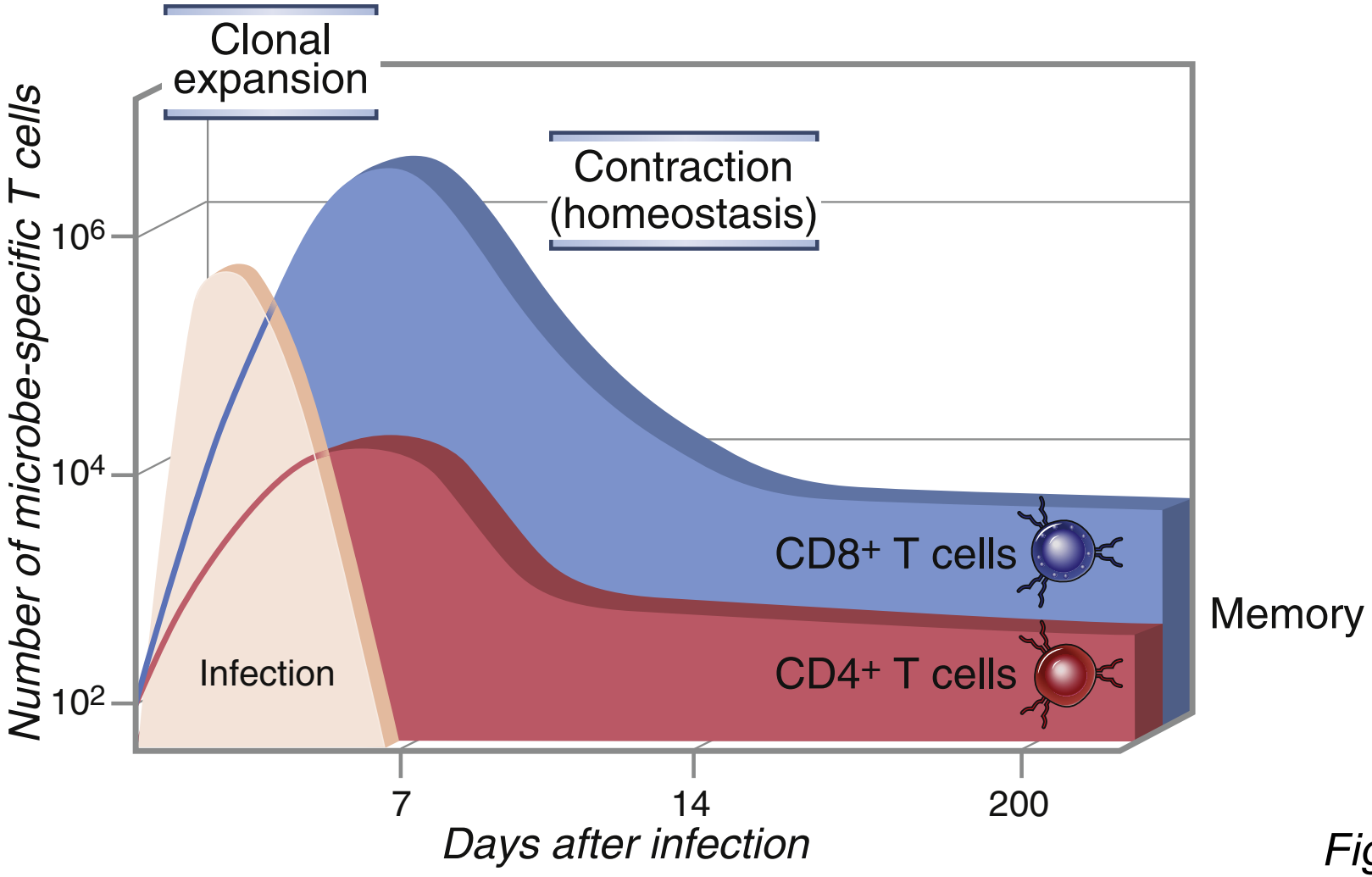
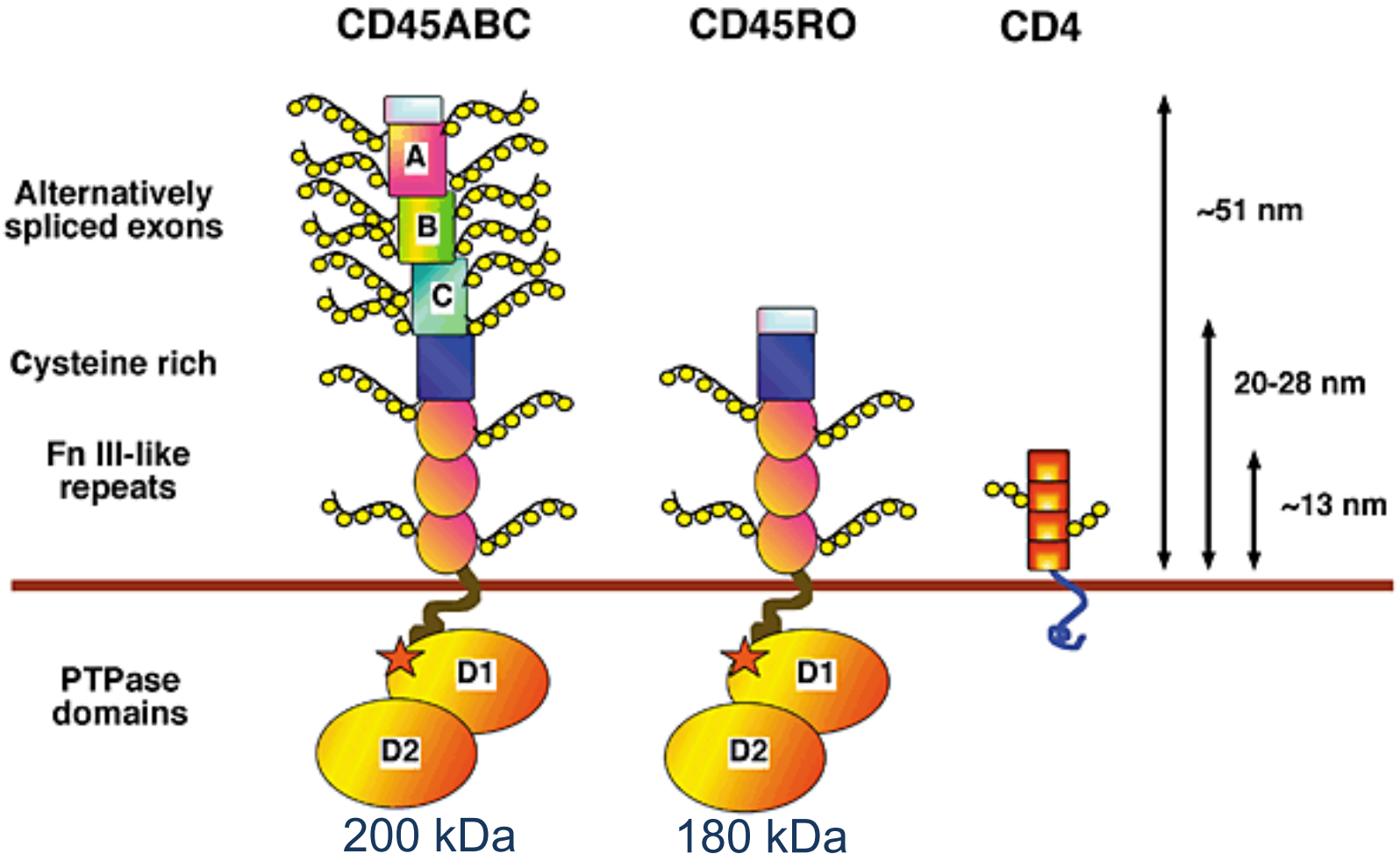


Fig 9-12

Important characteristics of memory T cells

2. Memory T cells express the CD45RO isoform



Shorter extracellular domain → tigher contact with TcR → more effective signal transduction

Important characteristics of memory T cells

3. Effector memory T cells migrate to peripheral tissues

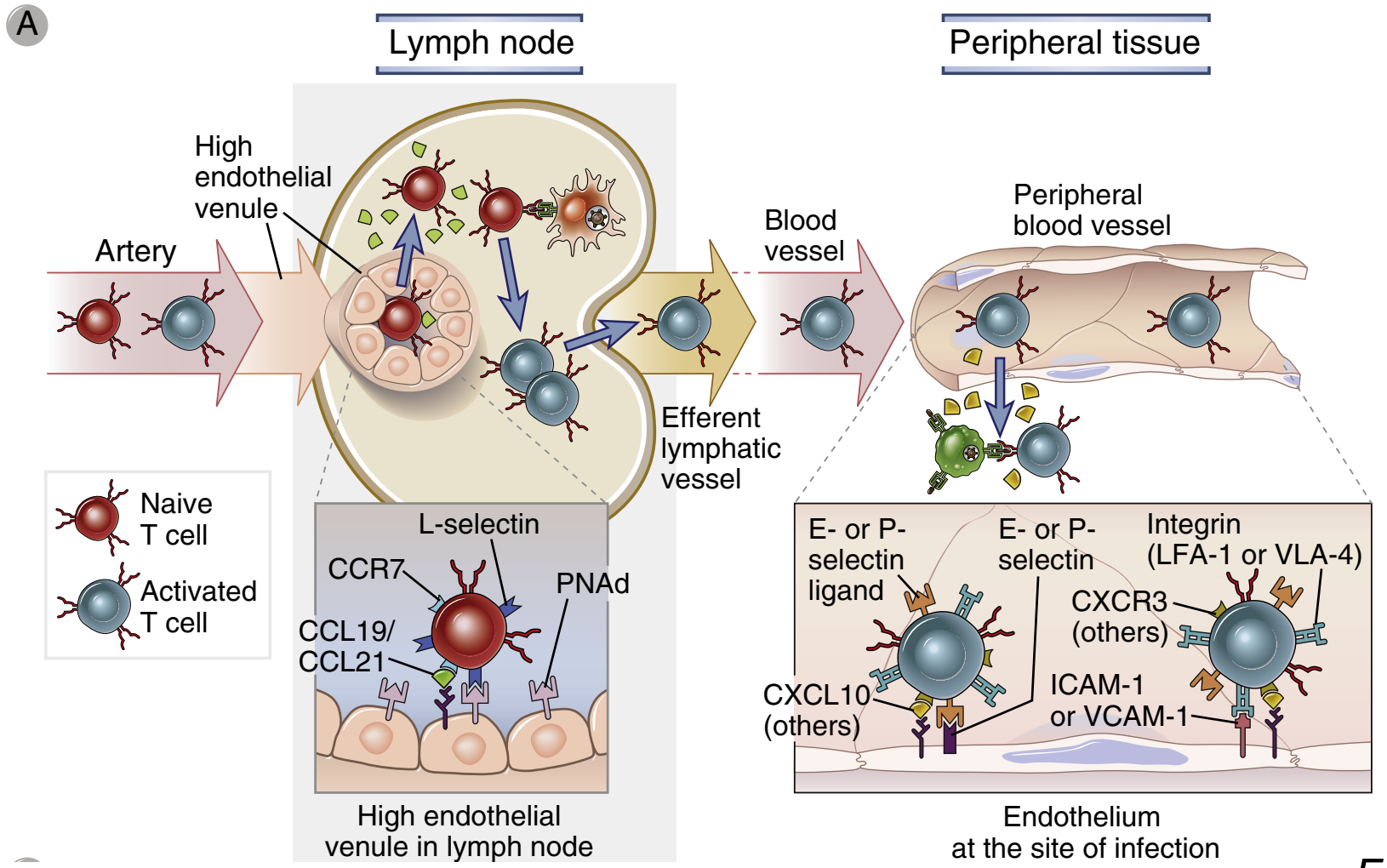


Fig 3-6

Important characteristics of memory T cells

4. Memory T cells are less dependent on costimulation

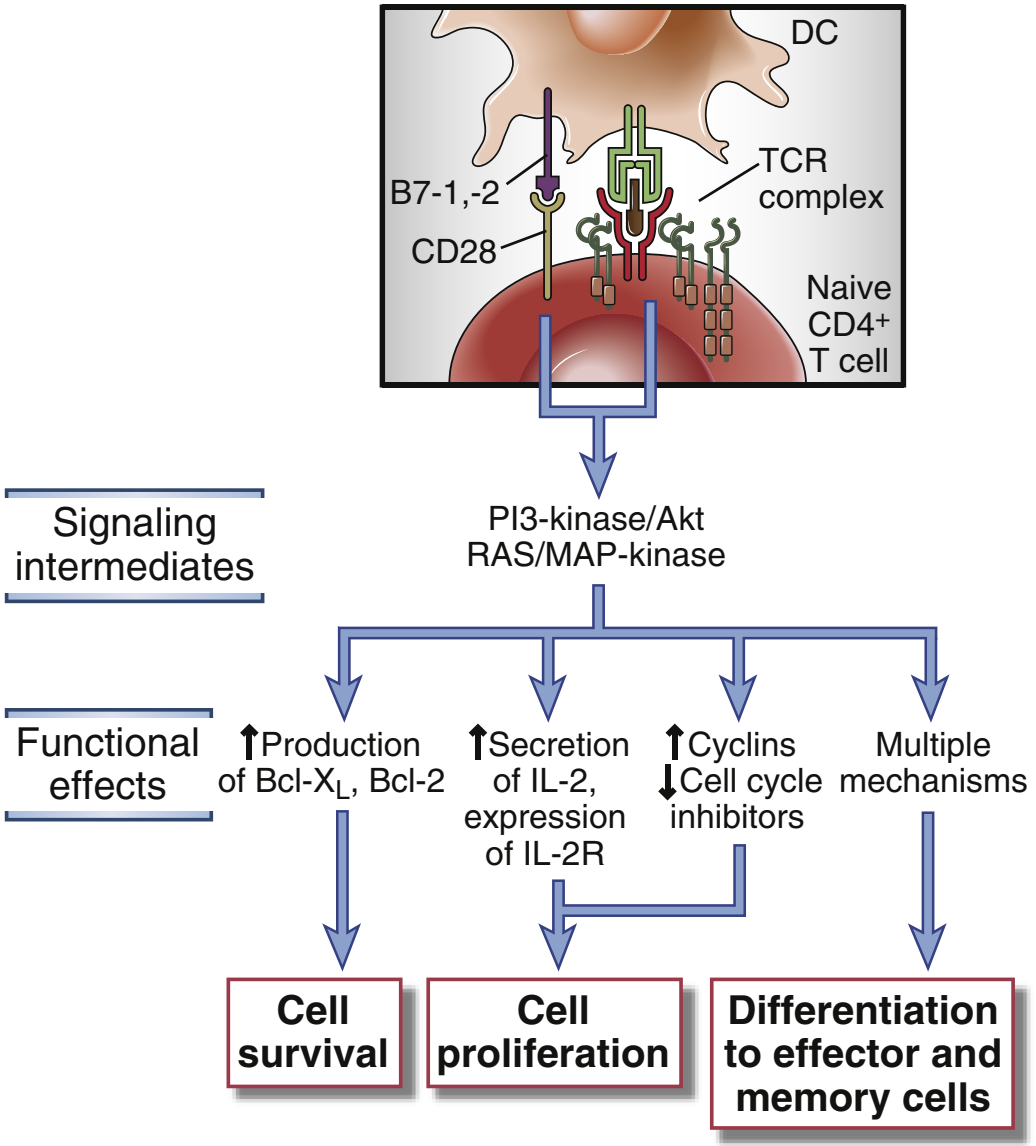


Fig 9-4

Changes in T cells during the immune response

T cell type	Naive	Effector	Memory
Phenotype	small	large, activated	small
High affinity IL-2R (CD25)	low	high	low
Lymph node homing receptor (CD62L)	high	low	low, variable
Adhesion molecules: Integrins, CD44	low	high	high
Chemokine receptor CCR7	high	low	variable
CD45 Isoform	CD45RA	CD45RO	CD45RO, variable
Effector function	After days	Yes	After hours !!!
APC	mainly DCs	-	B cells, macrophages, DCs
Migration, homing	Lymph nodes	Site of inflammation	Site of inflammation Mucosa, skin