

## Principali funzioni delle proteine

| Tipo di proteina      | Funzione                                     | Esempi                                                                                                                                                                                                                                                               |
|-----------------------|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Proteine strutturali  | Supporto                                     | Il collagene e l'elastina forniscono una trama fibrosa ai tessuti connettivi degli animali, quali tendini e legamenti. La cheratina è la proteina dei peli, dei corni, delle penne, delle piume e di altre appendici cutanee.                                        |
| Proteine di deposito  | Deposito di amminoacidi                      | L'ovalbumina è la proteina dell'albume delle uova utilizzata dall'embrione come riserva di amminoacidi durante lo sviluppo. La caseina, la proteina del latte, è la principale fonte di amminoacidi per il lattante. Le piante depositano amminoacidi nei loro semi. |
| Proteine di trasporto | Trasporto di altre sostanze                  | L'emoglobina, la proteina ematica contenente ferro, trasporta l'ossigeno dai polmoni alle altre parti dell'organismo. Altre proteine trasportano molecole attraverso le membrane cellulari.                                                                          |
| Proteine ormonali     | Coordinamento attività corporee              | L'insulina, un ormone secreto dal pancreas, contribuisce alla regolazione della concentrazione del glucosio nel sangue.                                                                                                                                              |
| Proteine recettoriali | Risposta della cellula a stimoli chimici     | I recettori presenti nella membrana di una cellula nervosa rispondono ai segnali chimici liberati da altre cellule nervose.                                                                                                                                          |
| Proteine contrattili  | Movimento                                    | L'actina e la miosina sono responsabili del movimento dei muscoli. Altre proteine contrattili sono responsabili del movimento ondulatorio di organelli noti come ciglia e flagelli.                                                                                  |
| Proteine di difesa    | Protezione contro le malattie                | Gli anticorpi combattono batteri e virus.                                                                                                                                                                                                                            |
| Proteine enzimatiche  | Accelerazione selettiva di reazioni chimiche | Gli enzimi digestivi idrolizzano le molecole polimeriche contenute negli alimenti.                                                                                                                                                                                   |

# **PROTEINE CON FUNZIONE DI RICONOSCIMENTO**

**Sistema immunitario  
Anticorpi**

**Recettori**

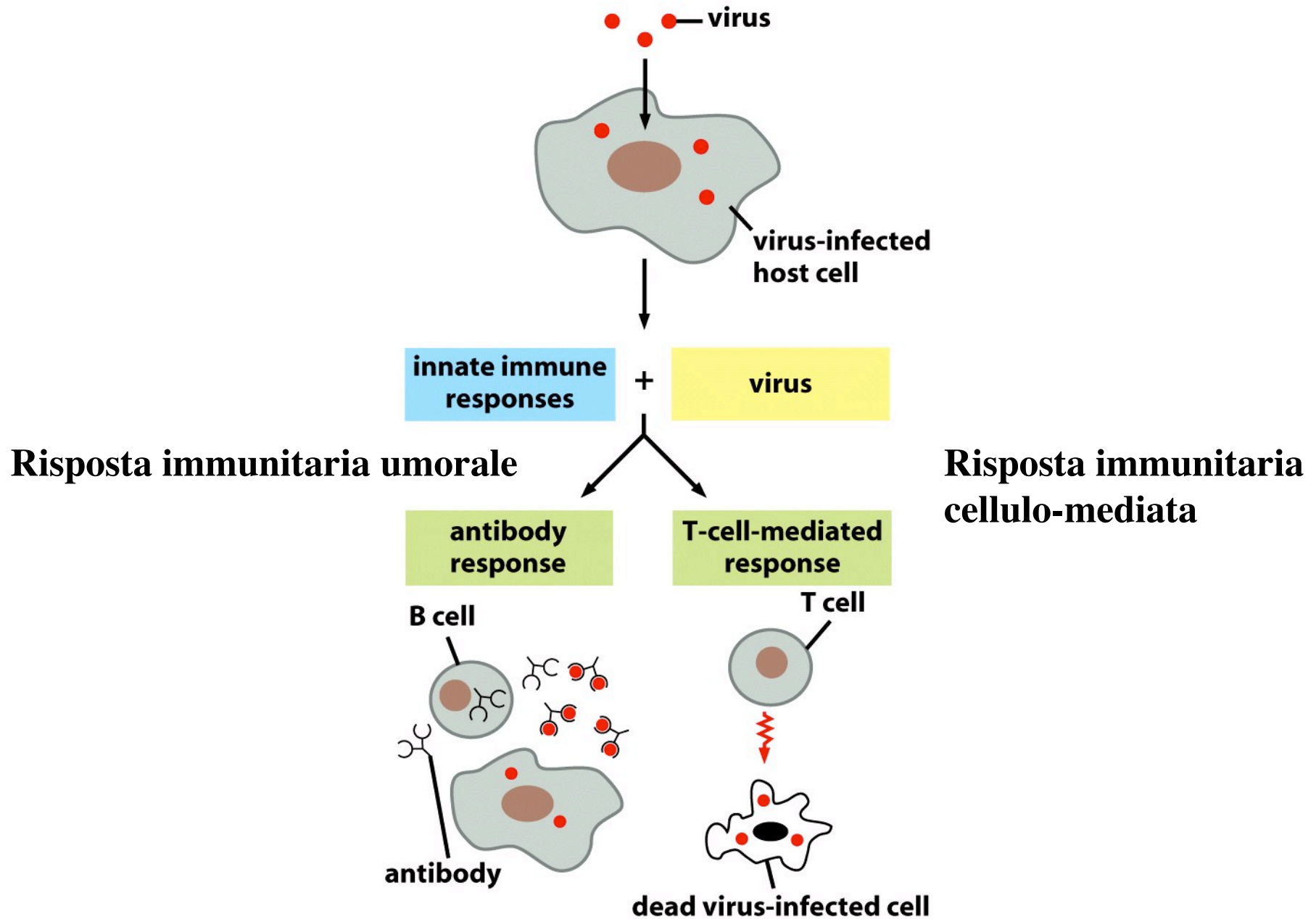


Figure 25-2 *Molecular Biology of the Cell* (© Garland Science 2008)

# Anticorpi

L' uomo è in grado di produrre circa  $10^8$  tipi di anticorpi diversi con distinte capacità e proprietà di legame.

L' induttore di risposta anticorpale prende il nome di ANTIGENE

La porzione di antigene riconosciuta dall' anticorpo viene detta  
DETERMINANTE ANTIGENICO o  
EPITOPO

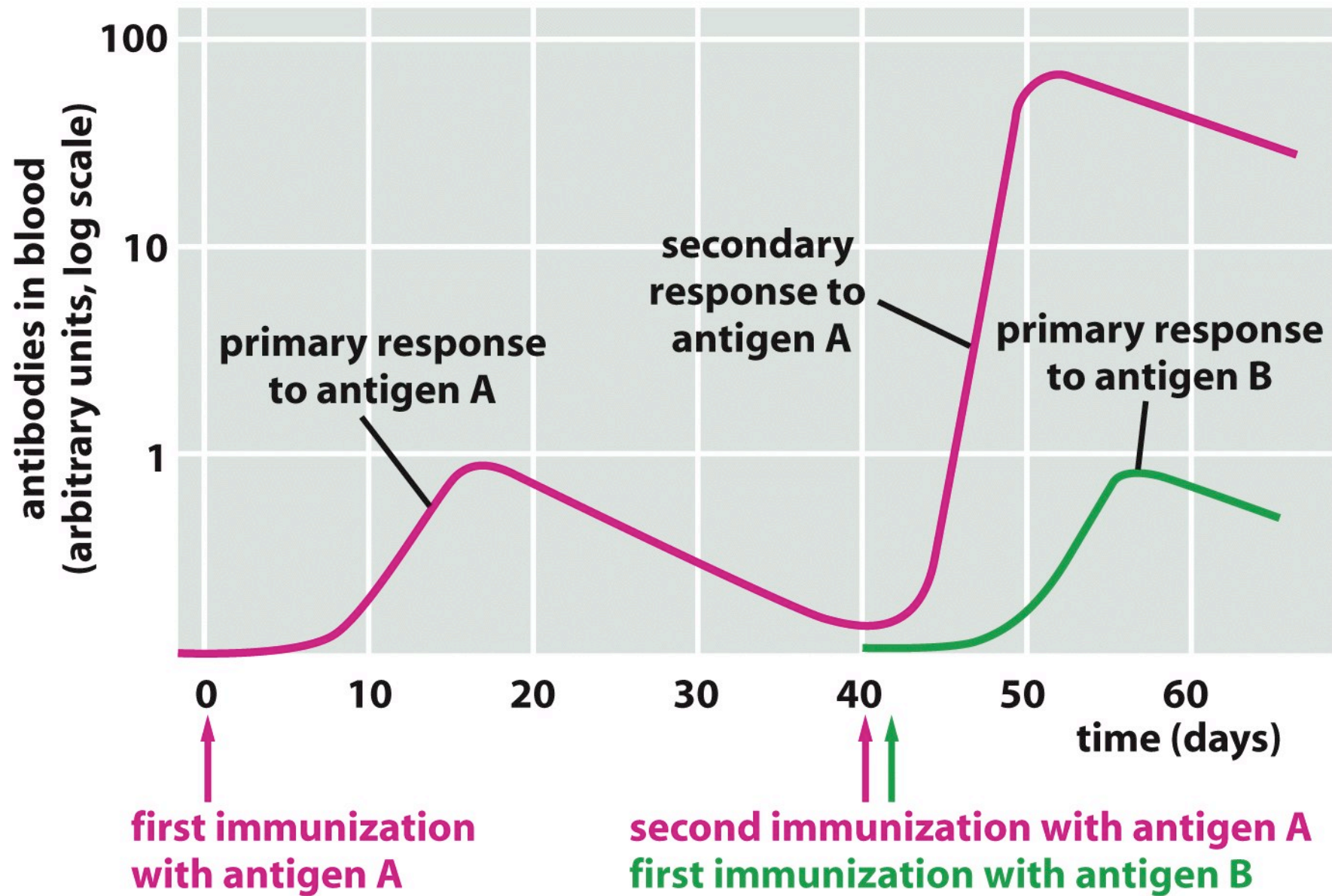


Figure 25-10 *Molecular Biology of the Cell* (© Garland Science 2008)

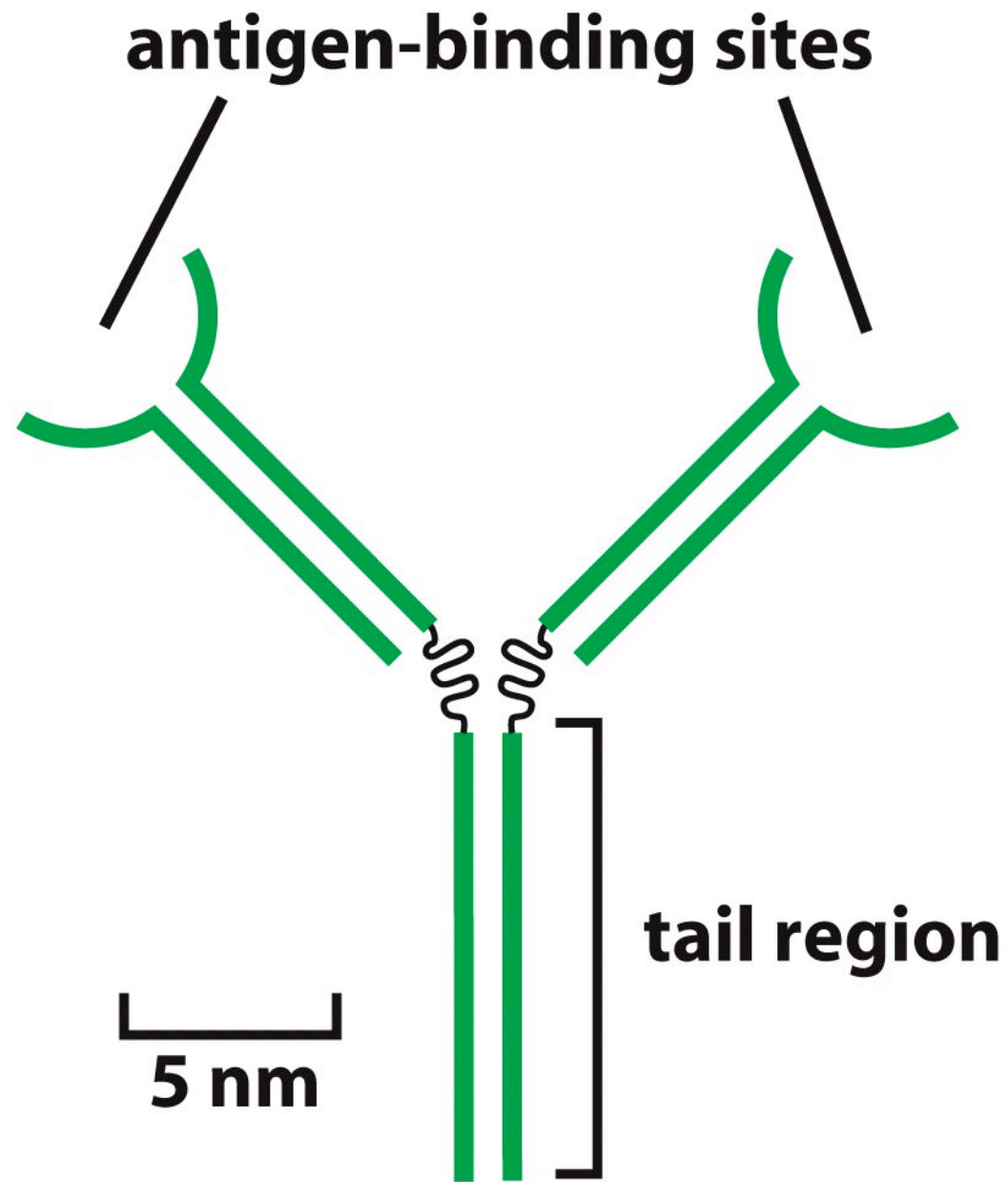


Figure 25-18 *Molecular Biology of the Cell* (© Garland Science 2008)



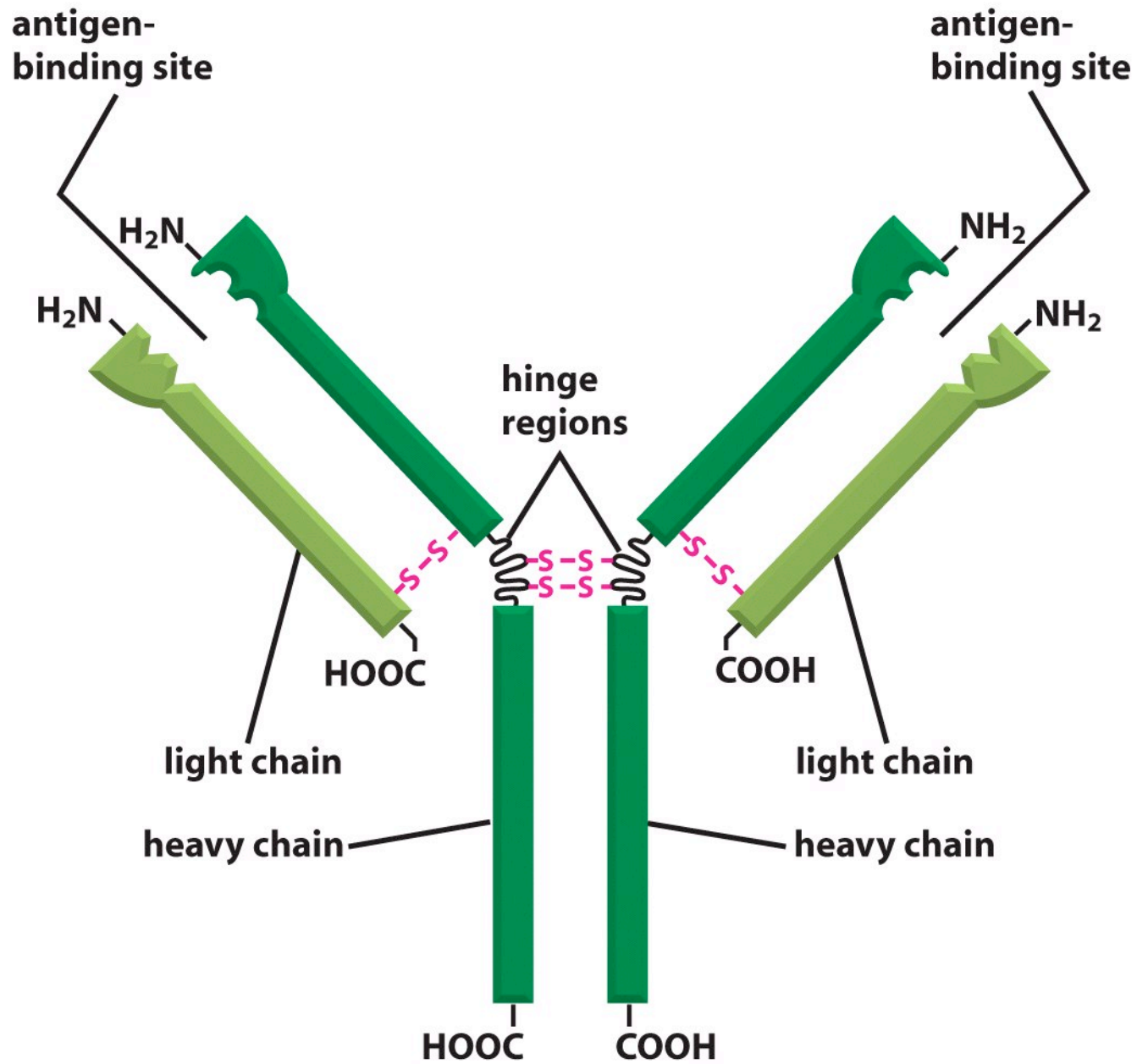
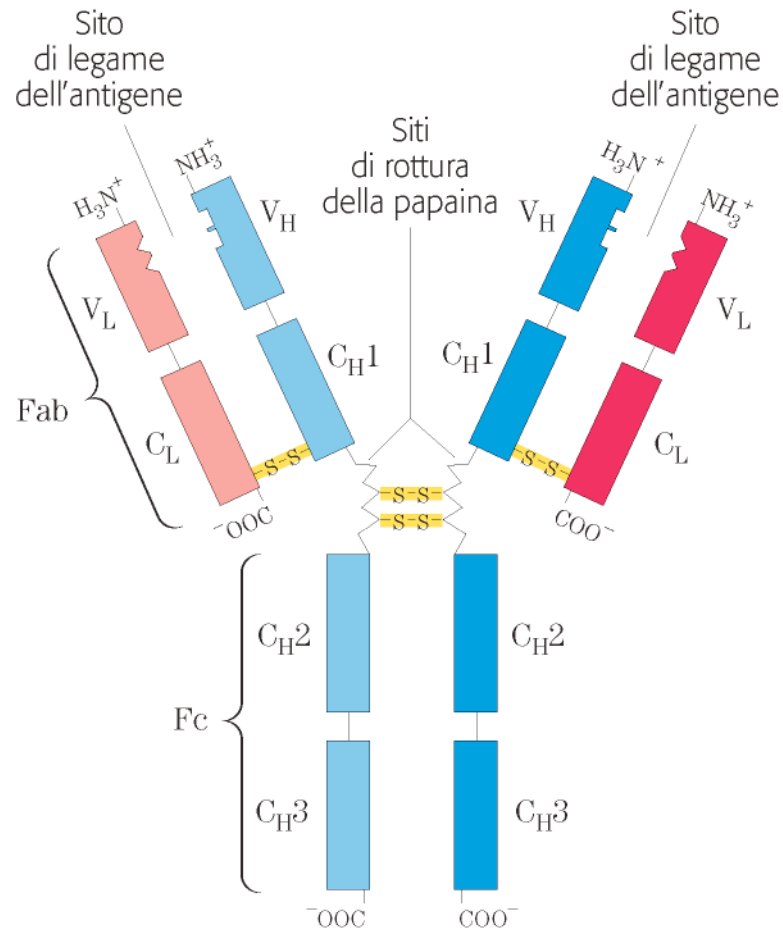
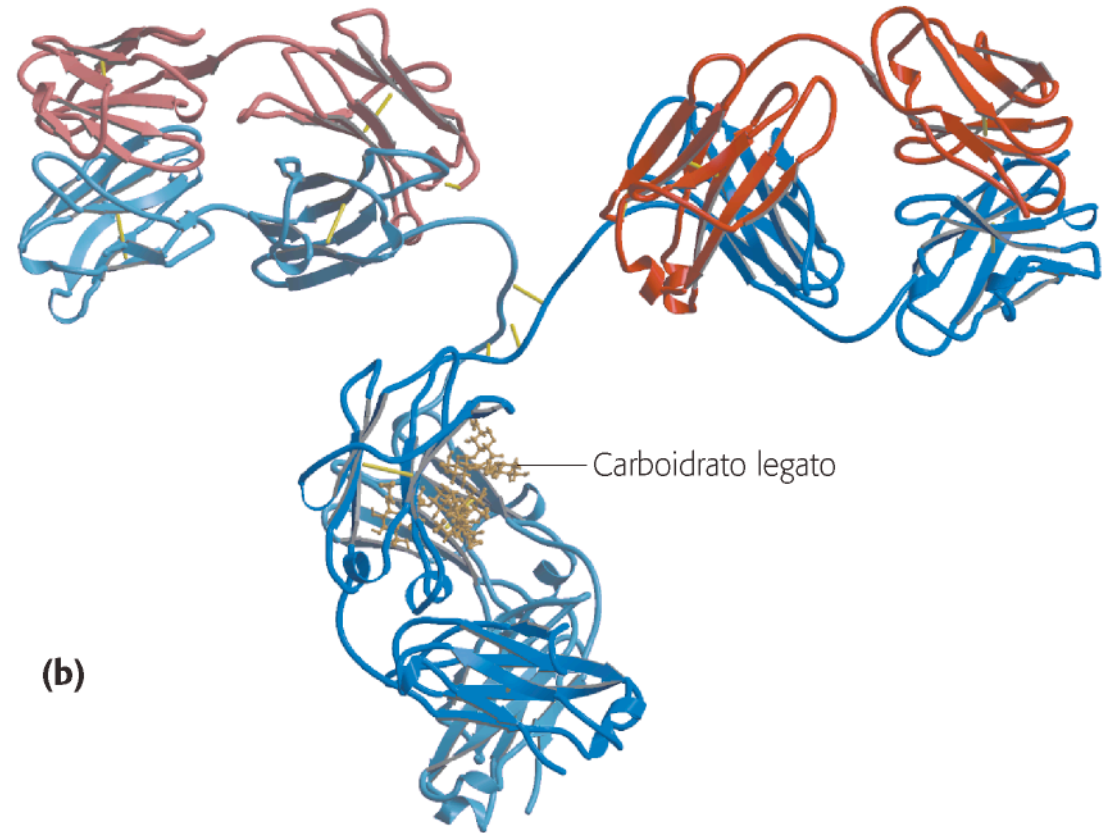


Figure 25-21 *Molecular Biology of the Cell* (© Garland Science 2008)

# Proteine con funzione di “riconoscimento”



C = dominio costante  
 V = dominio variabile  
 H, L = catena pesante; catena leggera



(b)

(a)



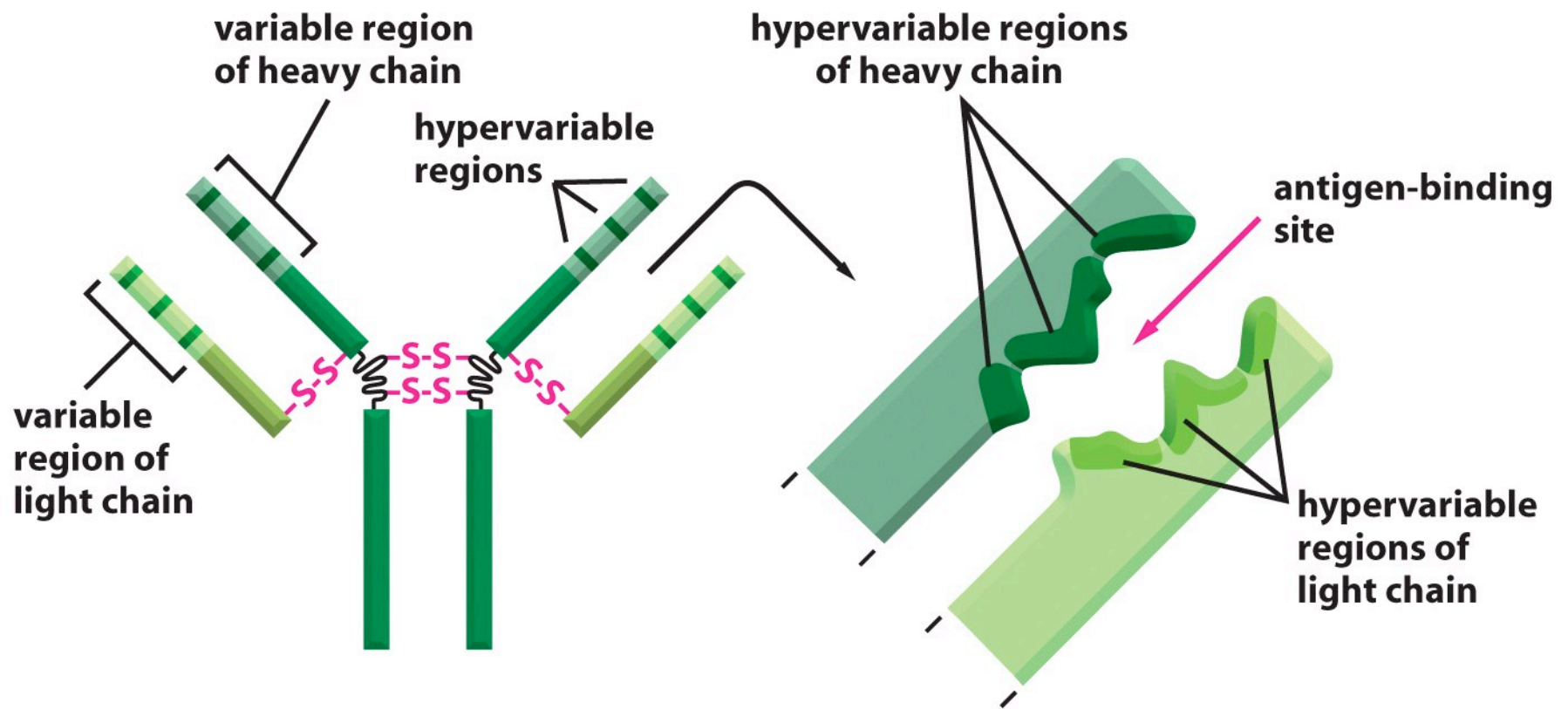


Figure 25-31 *Molecular Biology of the Cell* (© Garland Science 2008)

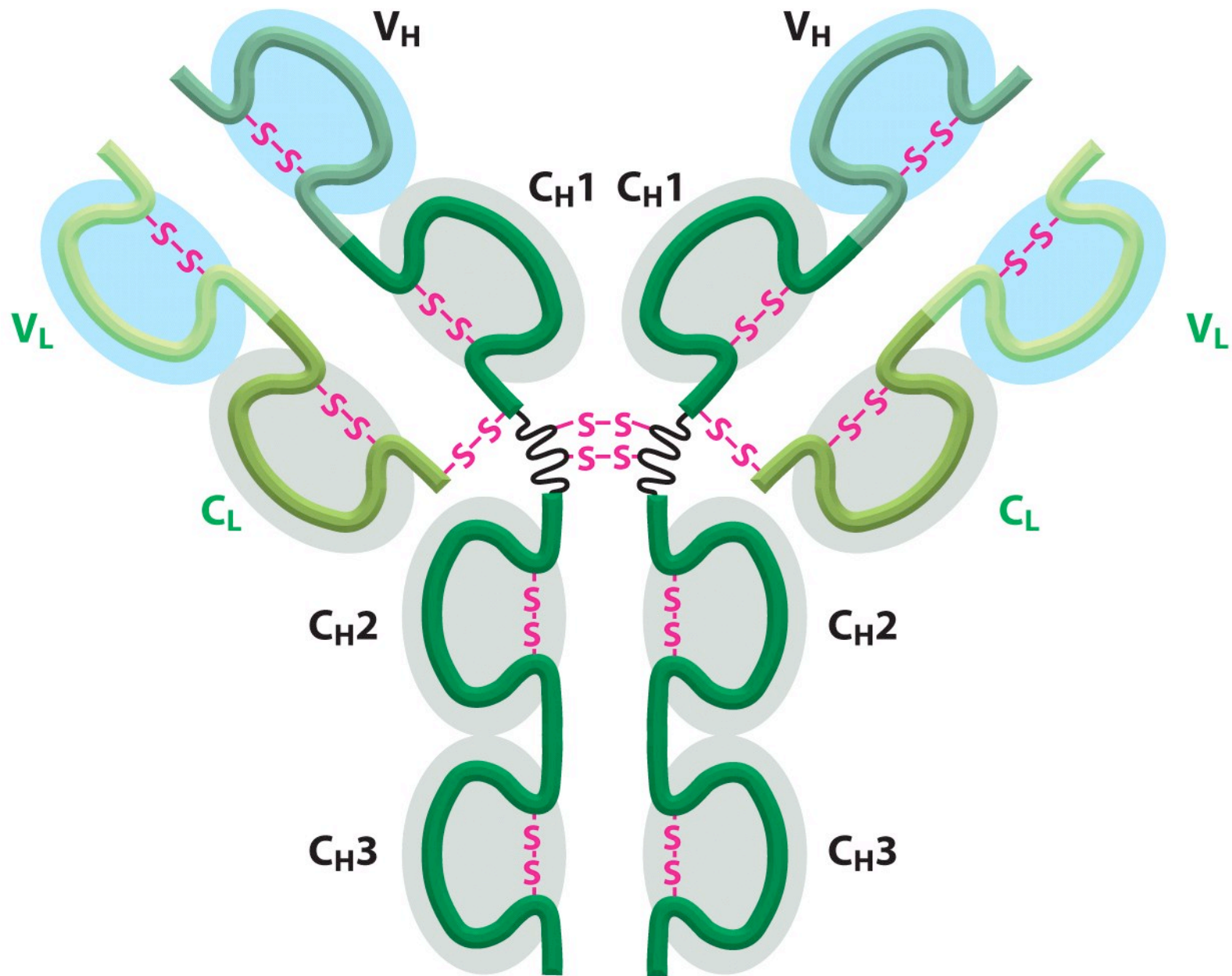
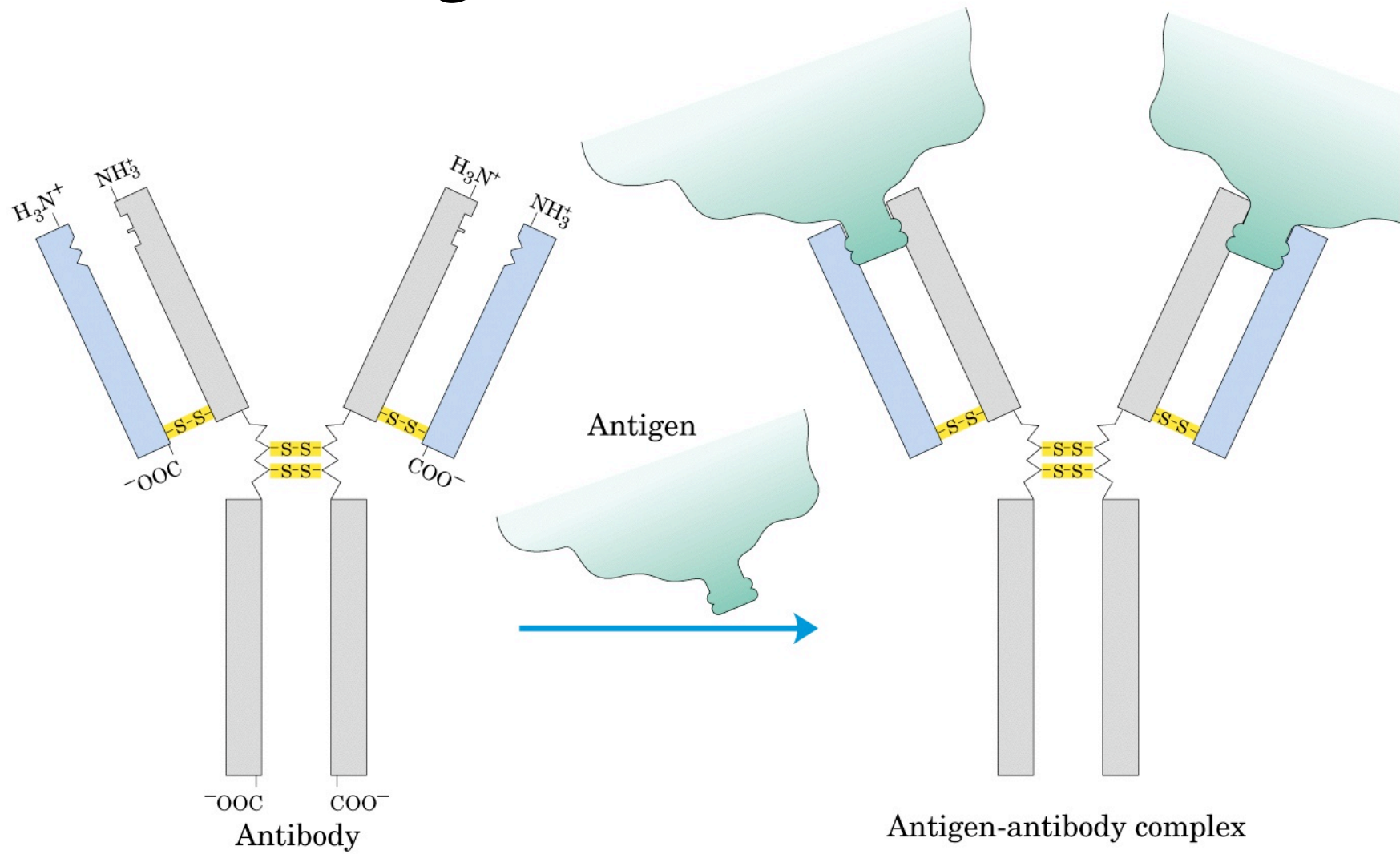


Figure 25-32 *Molecular Biology of the Cell* (© Garland Science 2008)

# Ab-Ag



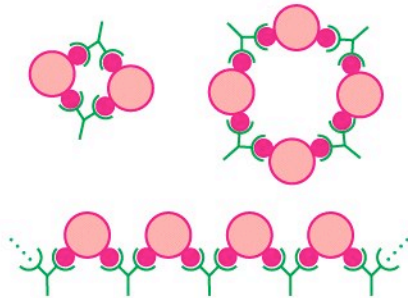
(A)

 **one antigenic determinant**



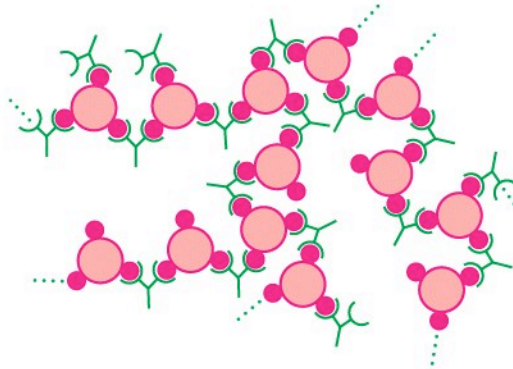
(B)

 **two identical antigenic determinants**



(C)

 **three or more identical antigenic determinants**



(D)

 **three or more different antigenic determinants**

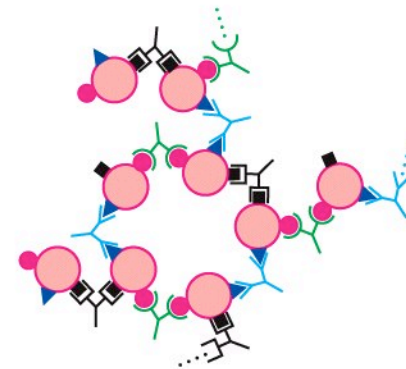


Figure 25-19 *Molecular Biology of the Cell* (© Garland Science 2008)

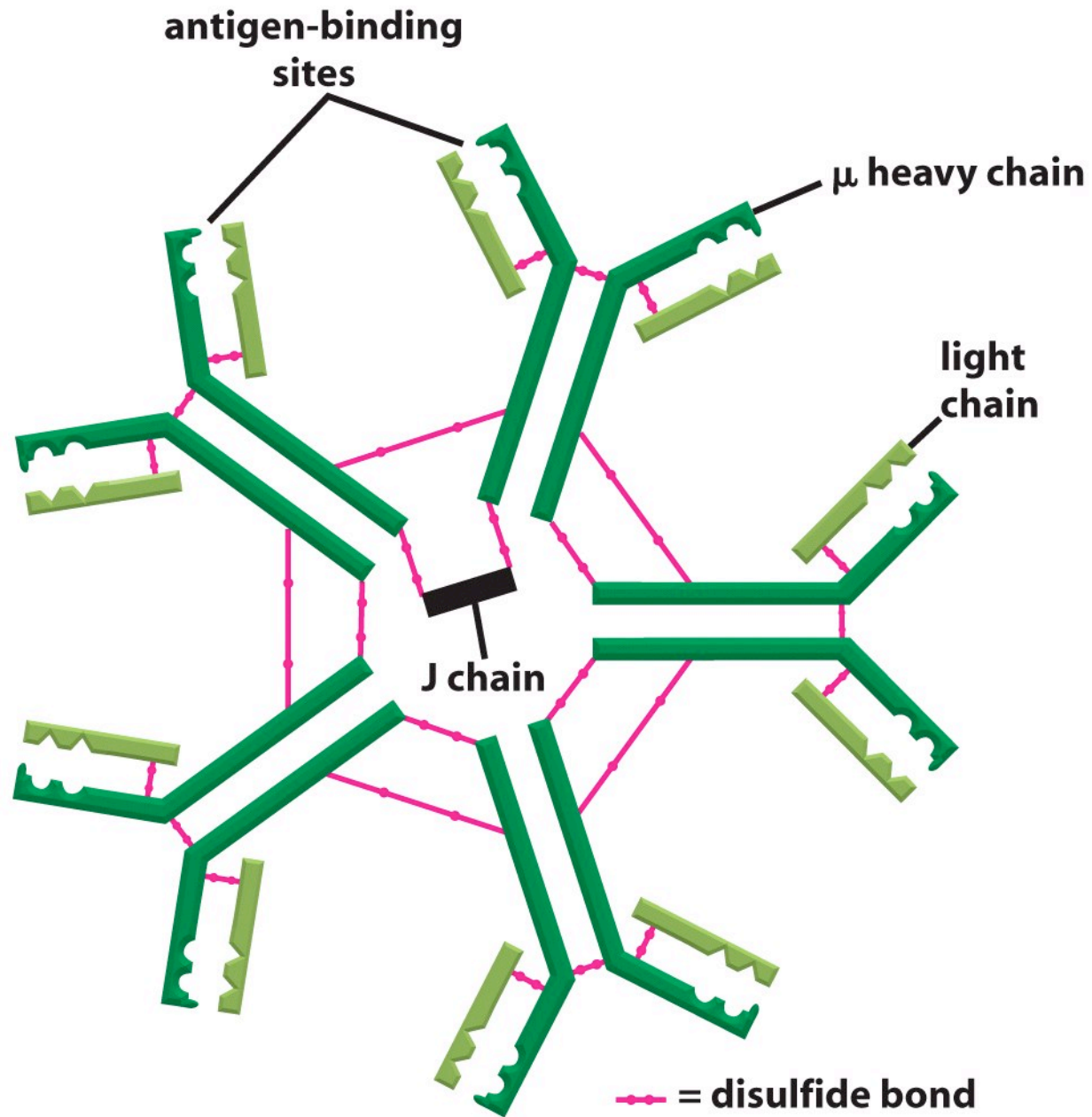
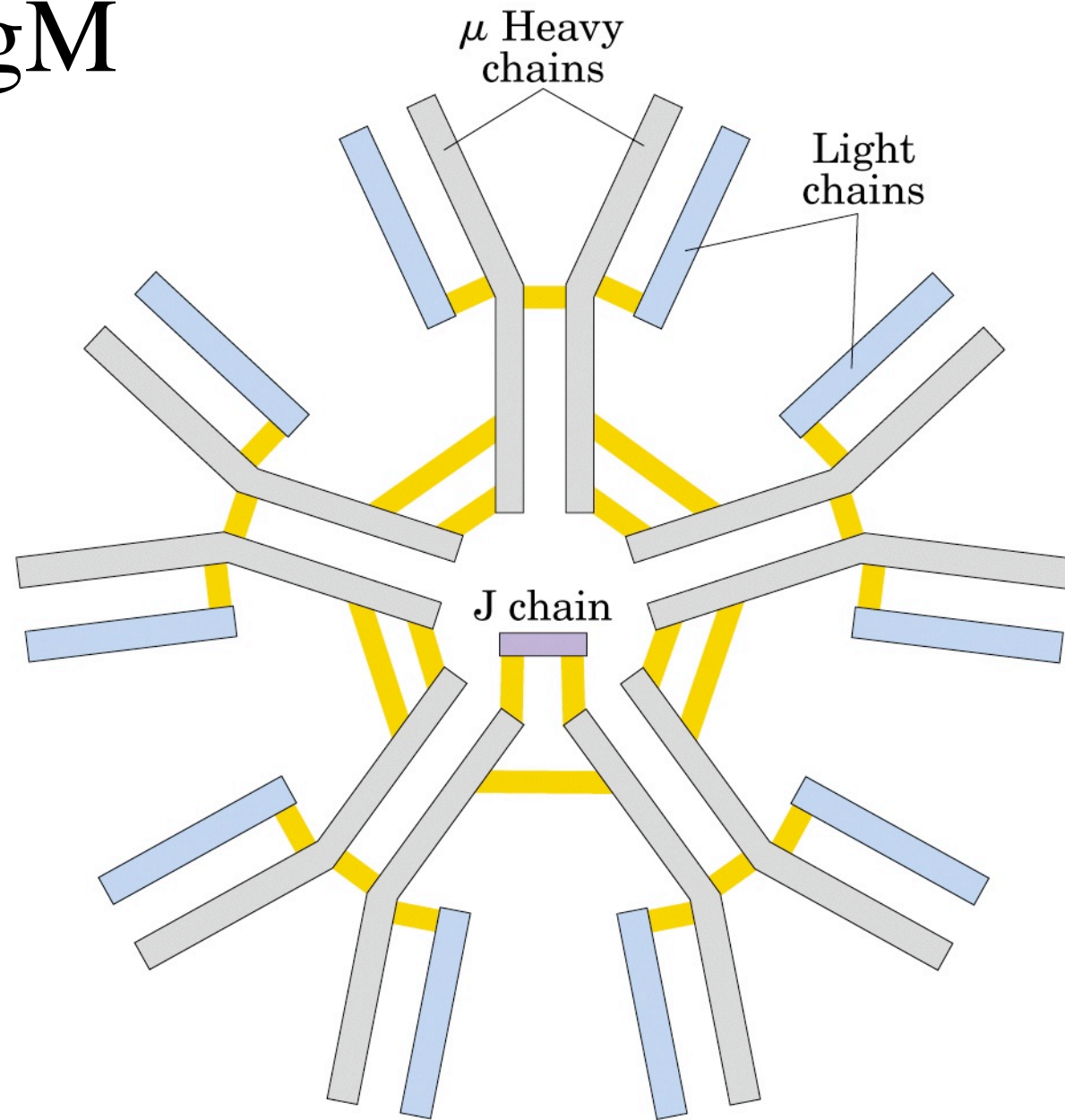


Figure 25-23 *Molecular Biology of the Cell* (© Garland Science 2008)

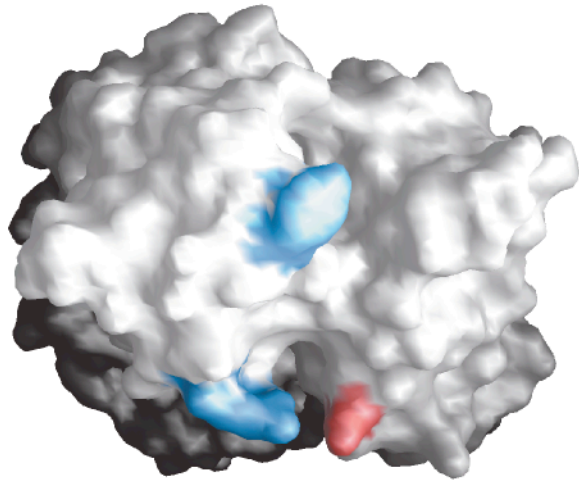


# IgM

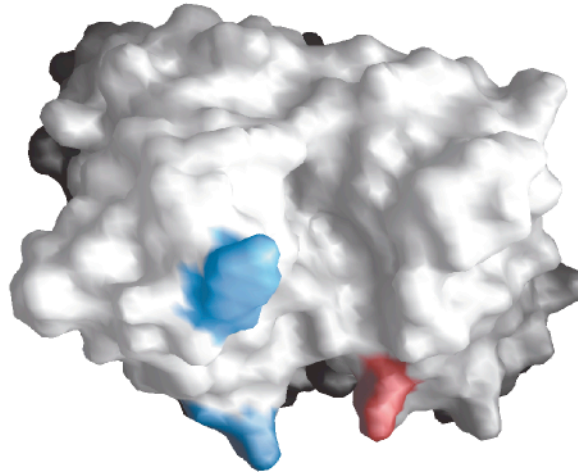




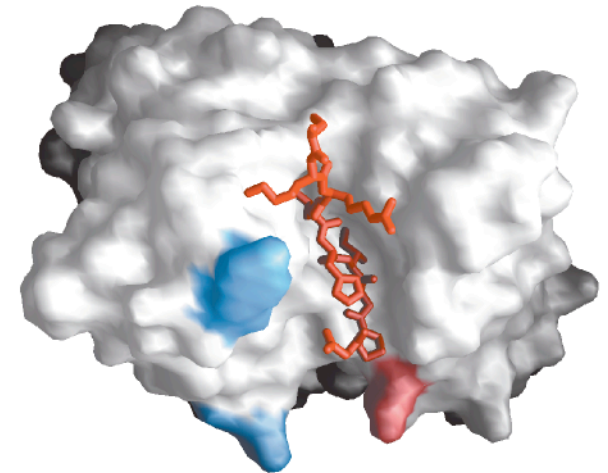
# Adattamento Indotto



**(a)** Conformazione senza antigene



**(b)** Conformazione con l'antigene (non mostrato)



**(c)** Conformazione con l'antigene (mostrato)

**Table 25–1 Properties of the Major Classes of Antibodies in Humans**

| PROPERTIES                           | CLASS OF ANTIBODY     |                       |                       |                       |                       |
|--------------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
|                                      | IgM                   | IgD                   | IgG                   | IgA                   | IgE                   |
| Heavy chains                         | $\mu$                 | $\delta$              | $\gamma$              | $\alpha$              | $\epsilon$            |
| Light chains                         | $\kappa$ or $\lambda$ | $\kappa$ or $\lambda$ | $\kappa$ or $\lambda$ | $\kappa$ or $\lambda$ | $\kappa$ or $\lambda$ |
| Number of four-chain units           | 5                     | 1                     | 1                     | 1 or 2                | 1                     |
| Percentage of total Ig in blood      | 10                    | <1                    | 75                    | 15                    | <1                    |
| Activates complement                 | ++++                  | –                     | ++                    | –                     | –                     |
| Crosses placenta                     | –                     | –                     | +                     | –                     | –                     |
| Binds to macrophages and neutrophils | –                     | –                     | +                     | –                     | –                     |
| Binds to mast cells and basophils    | –                     | –                     | –                     | –                     | +                     |

# Tipi cellulari associati alla risposta immunitaria

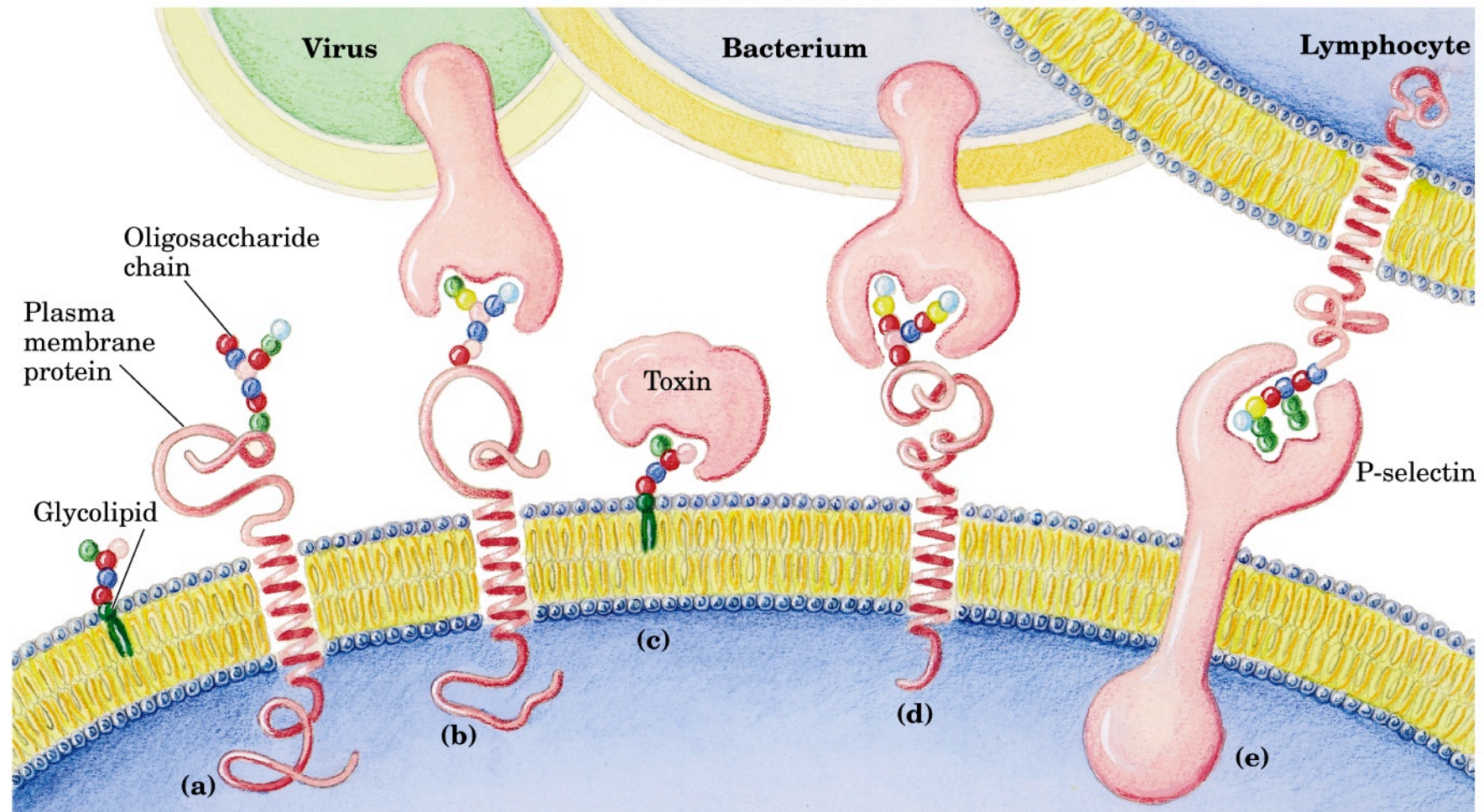
table 7-2

## Some Types of Leukocytes Associated with the Immune System

| Cell type                               | Function                                                                                                                  |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| <b>Macrophages</b>                      | Ingest large particles and cells by phagocytosis                                                                          |
| <b>B lymphocytes</b><br>(B cells)       | Produce and secrete antibodies                                                                                            |
| <b>T lymphocytes</b><br>(T cells)       |                                                                                                                           |
| Cytotoxic (killer)<br>T cells ( $T_C$ ) | Interact with infected host cells through receptors on T-cell surface                                                     |
| Helper T cells ( $T_H$ )                | Interact with macrophages and secrete cytokines (interleukins) that stimulate $T_C$ , $T_H$ , and B cells to proliferate. |



# Processi di riconoscimento e di adesione cellulare



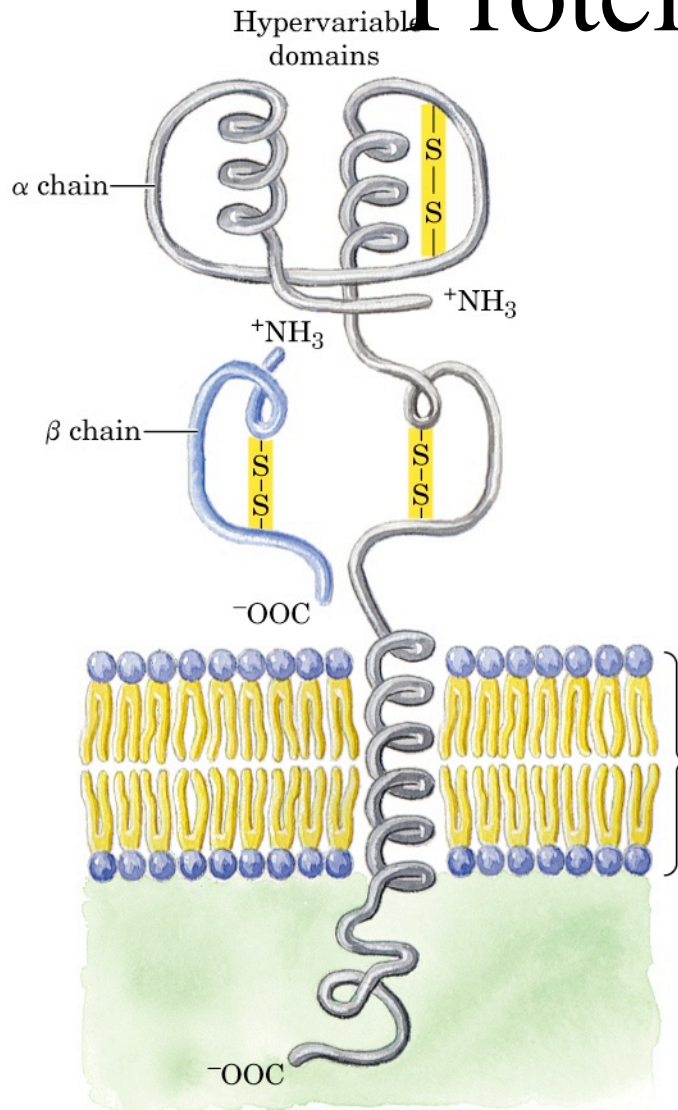
# SISTEMA MHC

## (complesso maggiore di istocompatibilità)

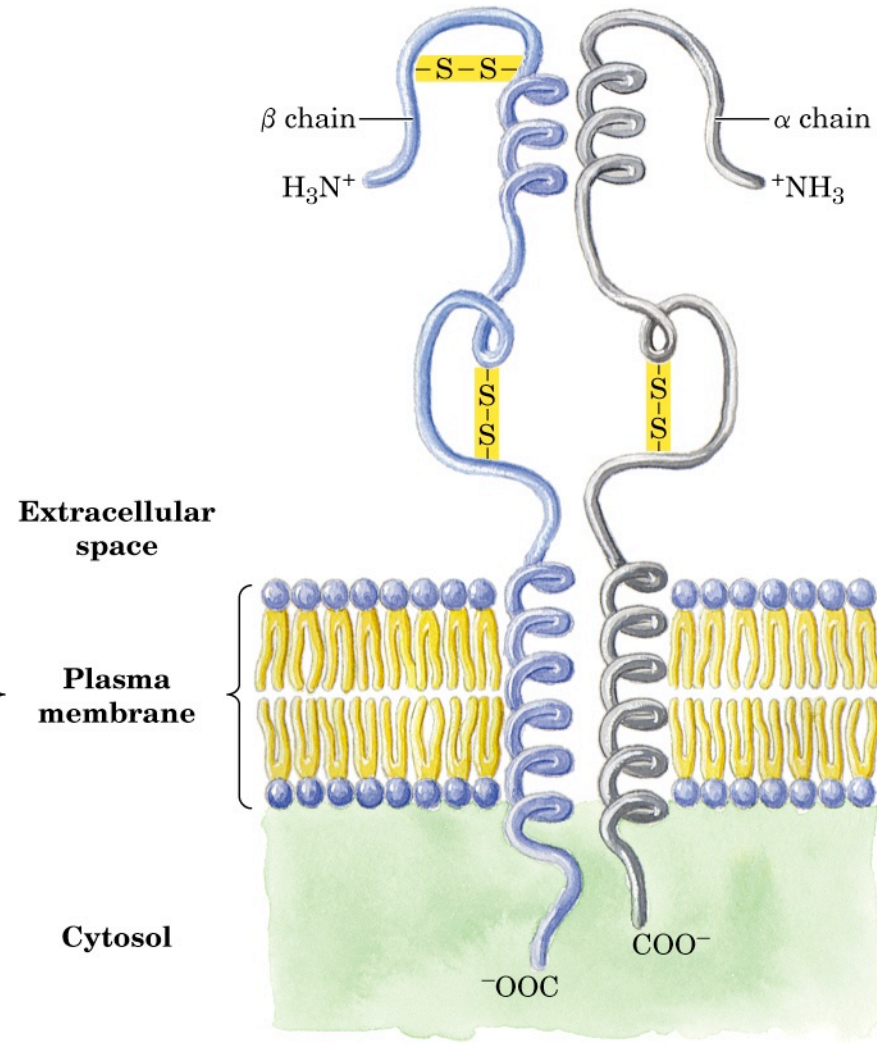
Le proteine MHC legano frammenti proteici, prodotto di digestione di proteine endogene (self) o, se la cellula è infettata, di proteine virali (non self) e li espongono sulla superficie della cellula.

La presentazione dell' antigene, consente la discriminazione tra self e non self da parte del sistema immunitario

# Proteine MHC



(a) Class I MHC protein



(b) Class II MHC protein



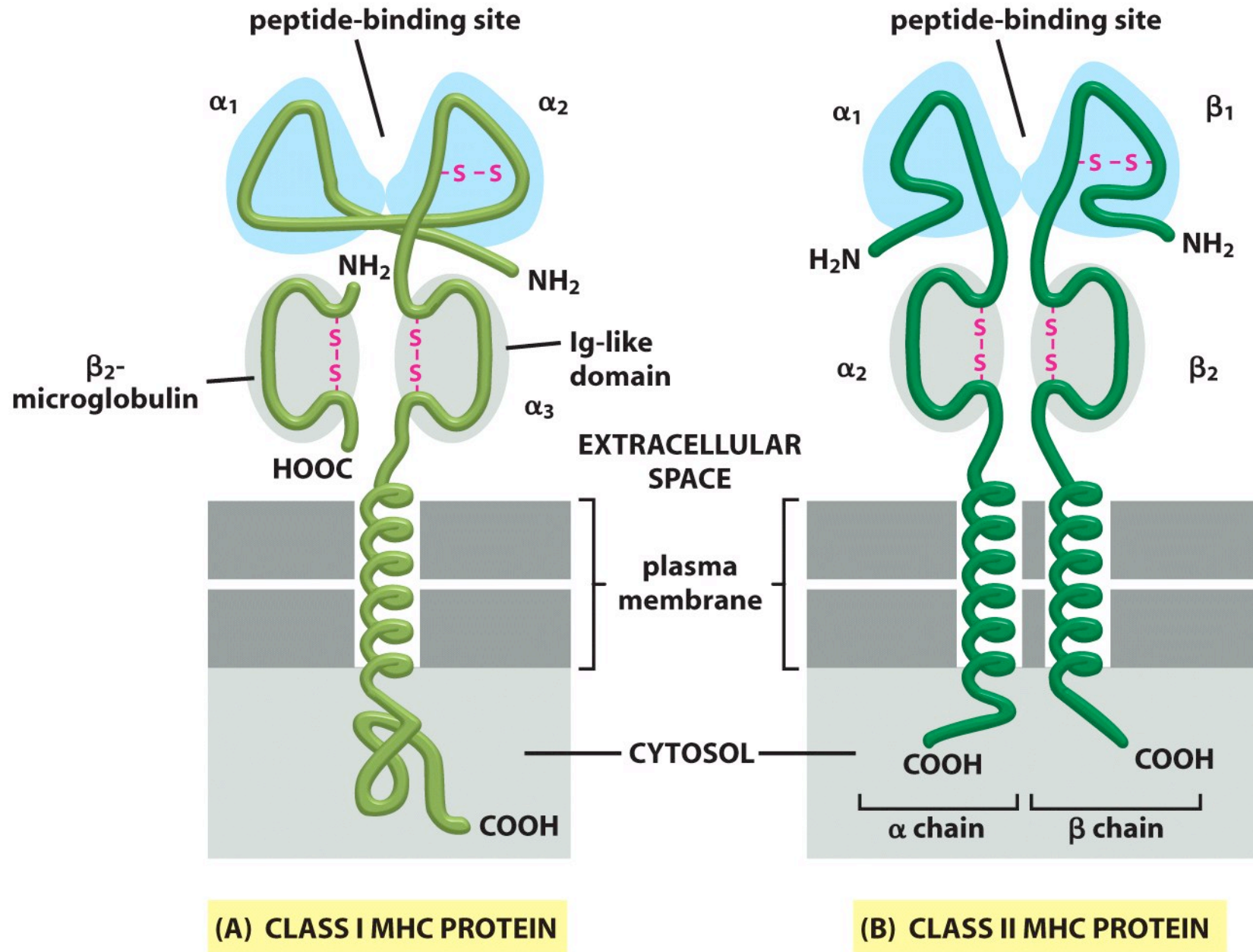


Figure 25-50 *Molecular Biology of the Cell* (© Garland Science 2008)

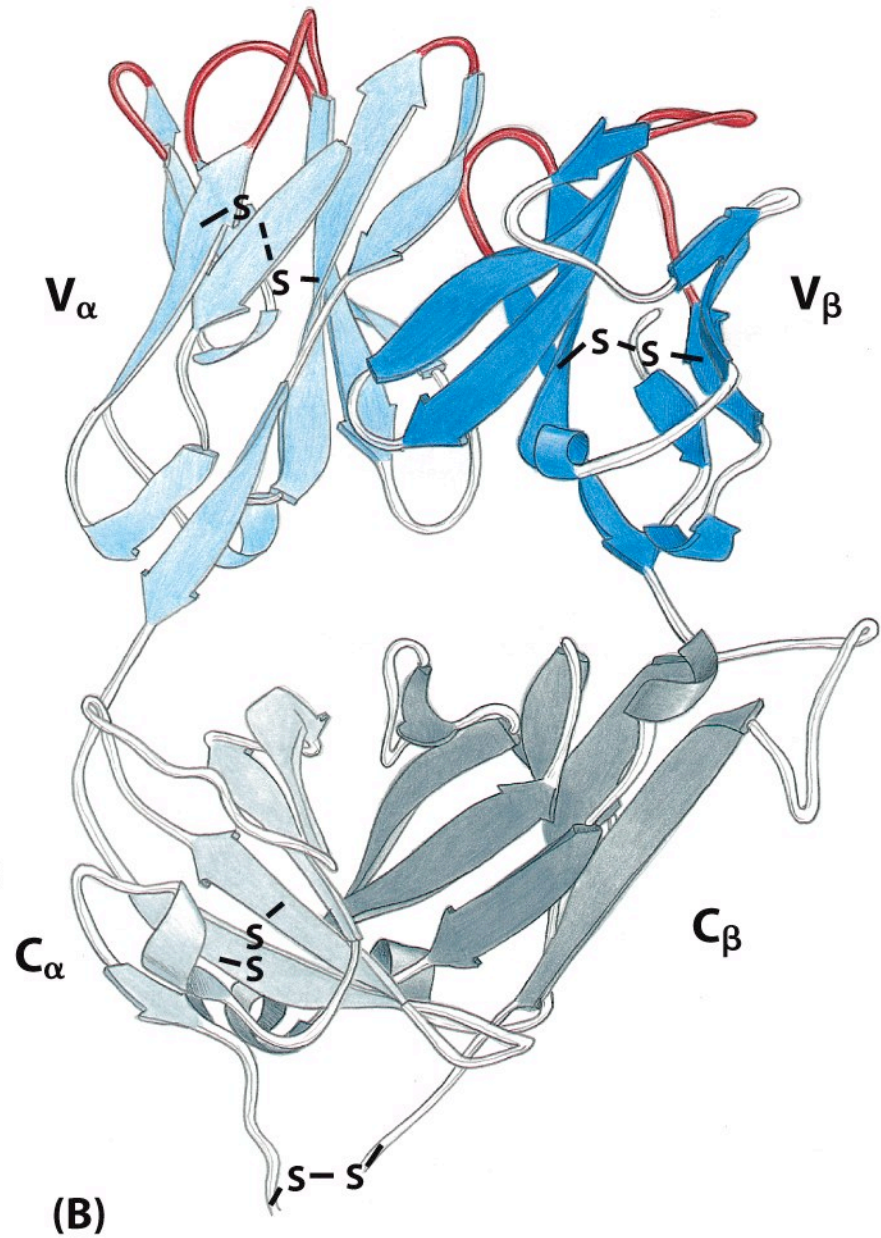
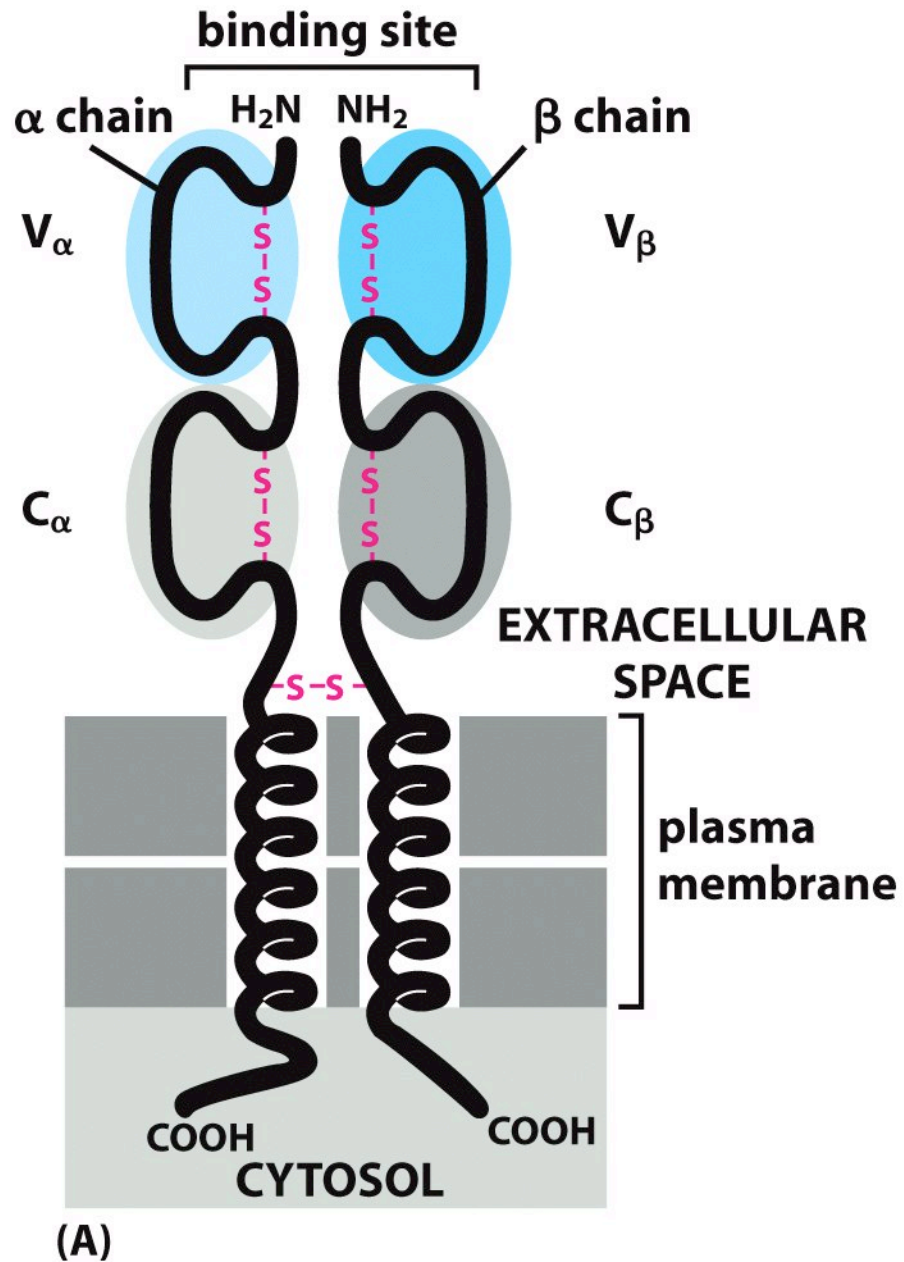
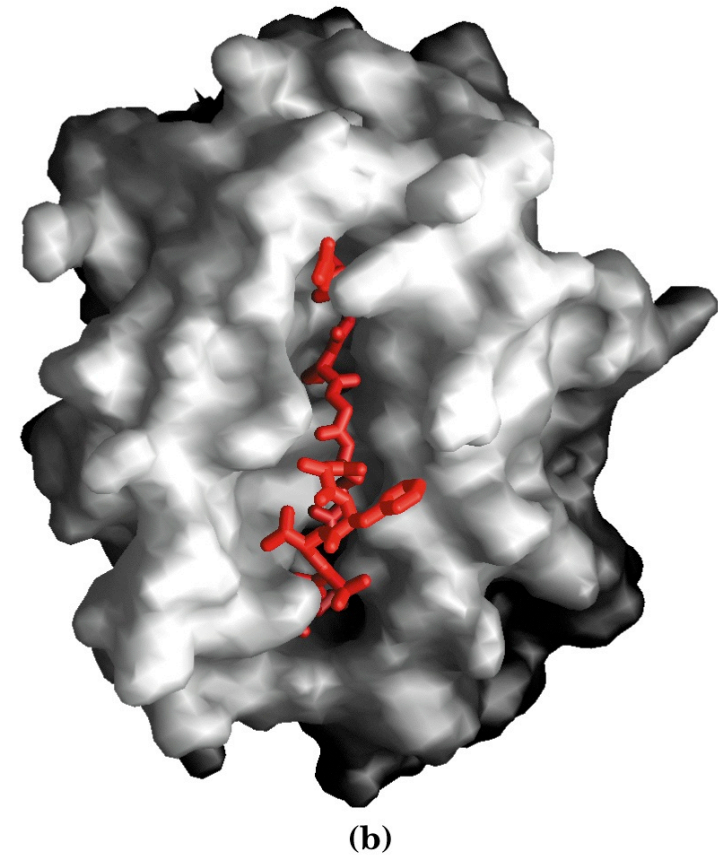
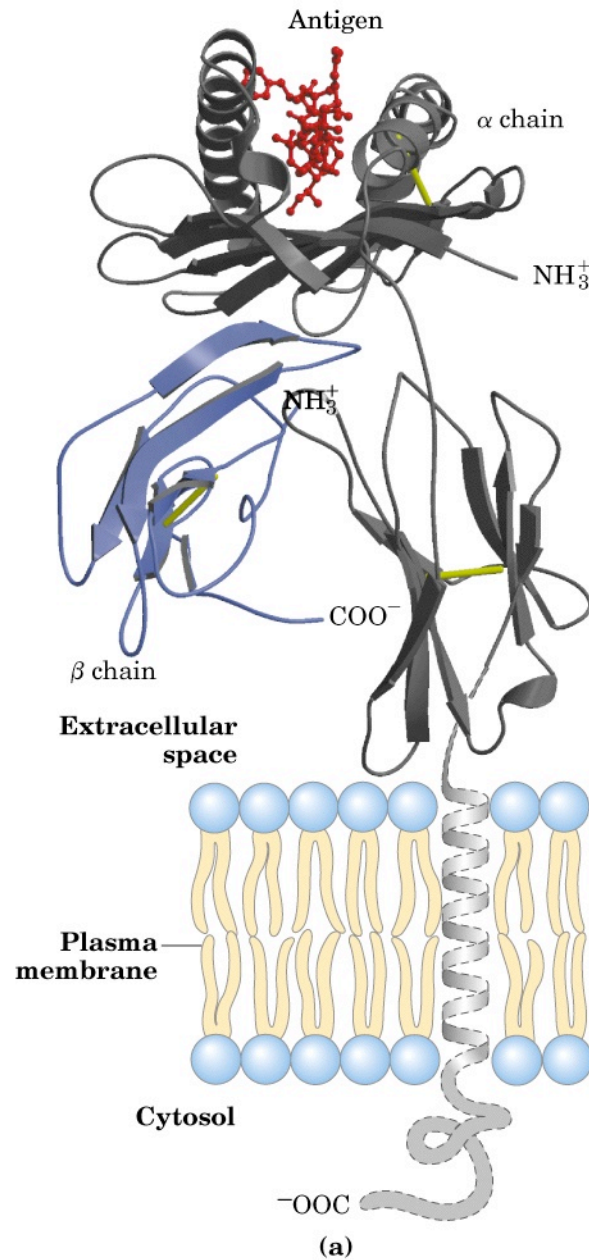


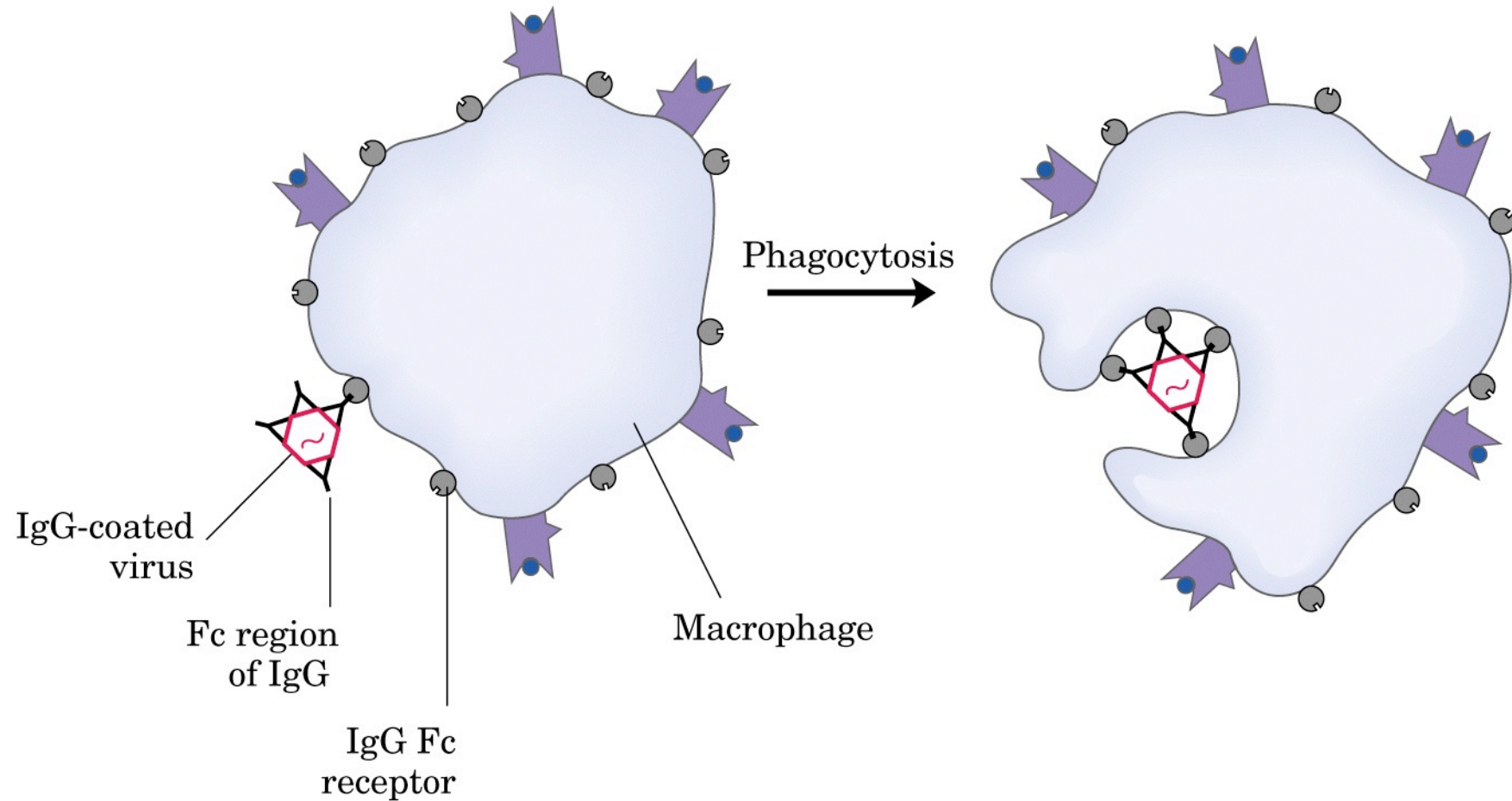
Figure 25-43 *Molecular Biology of the Cell* (© Garland Science 2008)

# Presentazione dell' antigene





# Fagocitosi

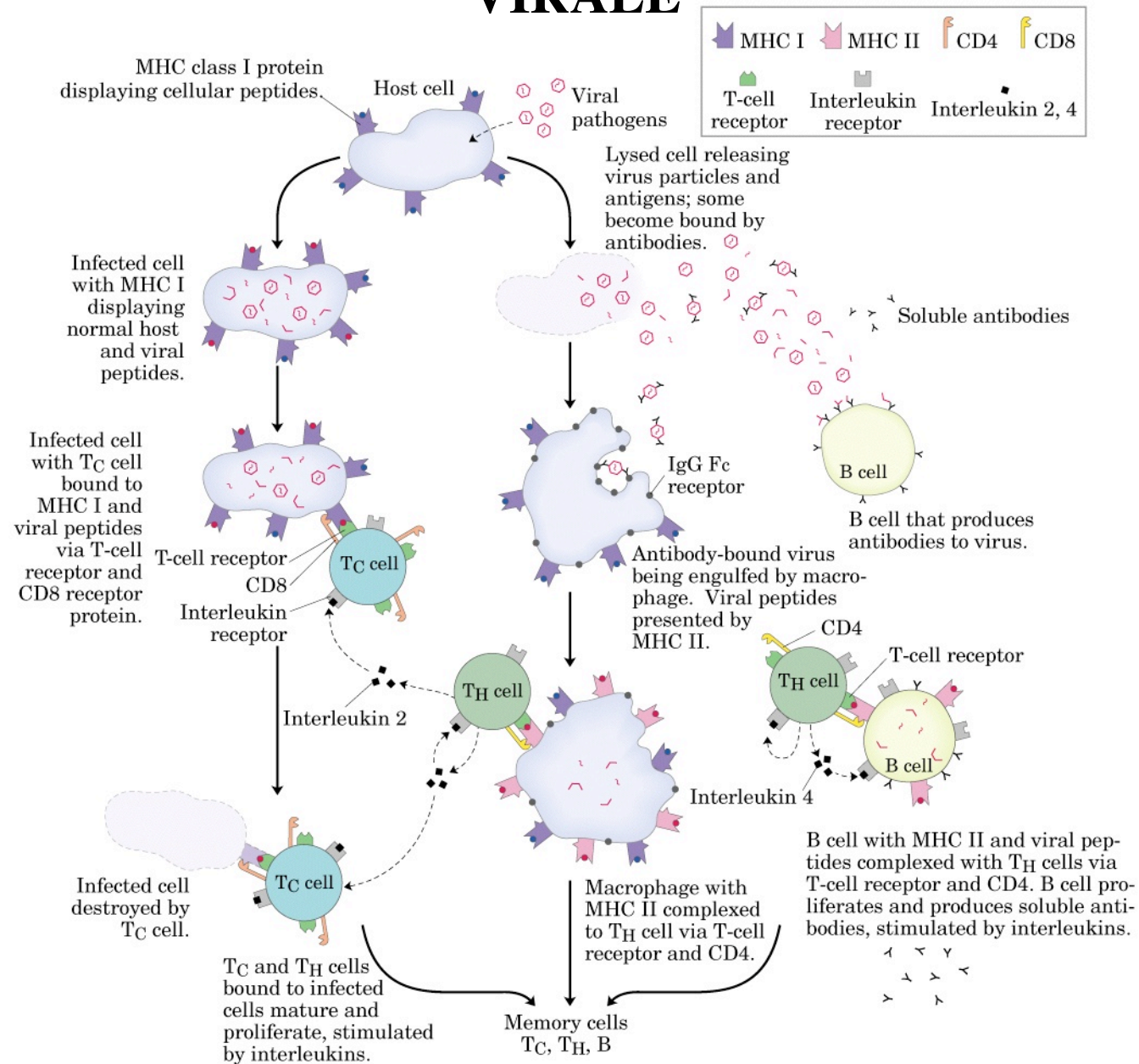


**Table 25–2 Properties of Human Class I and Class II MHC Proteins**

|                                    | <b>CLASS I</b>                            | <b>CLASS II</b>                                                             |
|------------------------------------|-------------------------------------------|-----------------------------------------------------------------------------|
| <b>Genetic loci</b>                | <i>HLA-A, HLA-B, HLA-C</i>                | <i>DP, DQ, DR</i>                                                           |
| <b>Chain structure</b>             | $\alpha$ chain + $\beta_2$ -microglobulin | $\alpha$ chain + $\beta$ chain                                              |
| <b>Cell distribution</b>           | most nucleated cells                      | dendritic cells, B cells, macrophages, thymus epithelial cells, some others |
| <b>Presents antigen to</b>         | cytotoxic T cells                         | helper T cells, regulatory T cells                                          |
| <b>Source of peptide fragments</b> | mainly proteins made in cytoplasm         | mainly endocytosed plasma membrane and extracellular proteins               |
| <b>Polymorphic domains</b>         | $\alpha_1 + \alpha_2$                     | $\alpha_1 + \beta_1$                                                        |
| <b>Recognition by co-receptor</b>  | CD8                                       | CD4                                                                         |

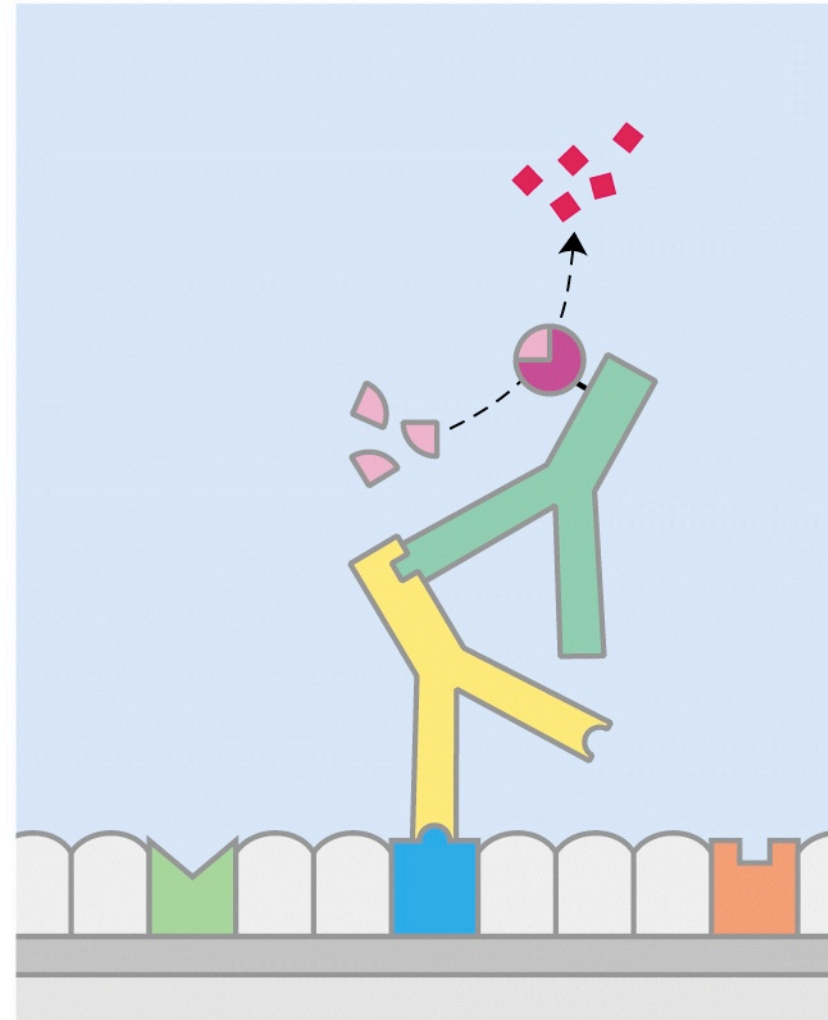


# RISPOSTA IMMUNITARIA AD UNA INFEZIONE VIRALE



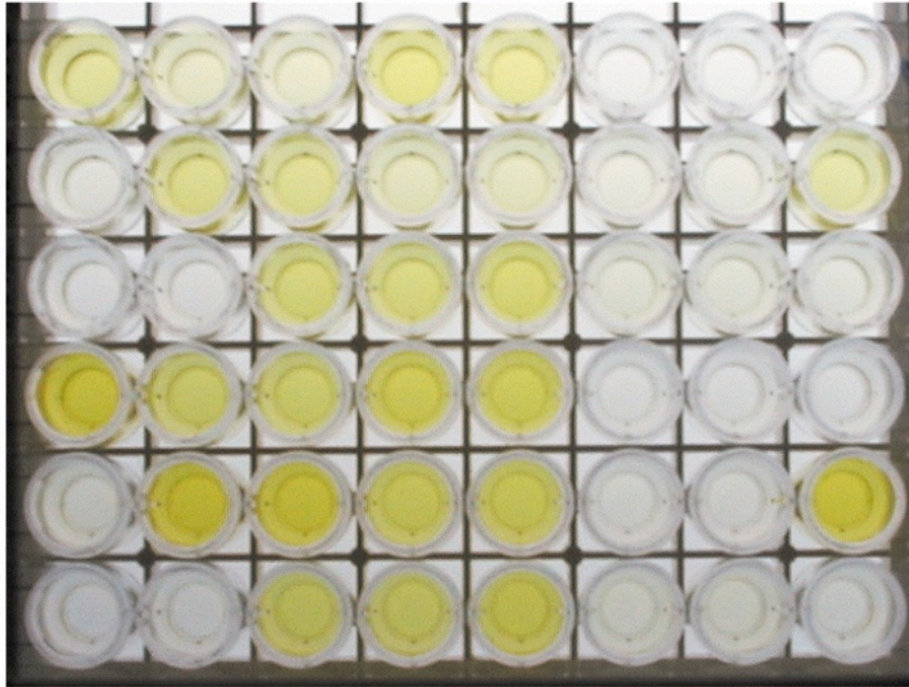
# Tecniche immunologiche

- ① Coat surface with sample   
(antigens).
- ② Block unoccupied sites with nonspecific protein. 
- ③ Incubate with primary antibody against specific antigen. 
- ④ Incubate with antibody-enzyme complex that binds primary antibody. 
- ⑤ Add substrate. 
- ⑥ Formation of colored product indicates presence of specific antigen. 



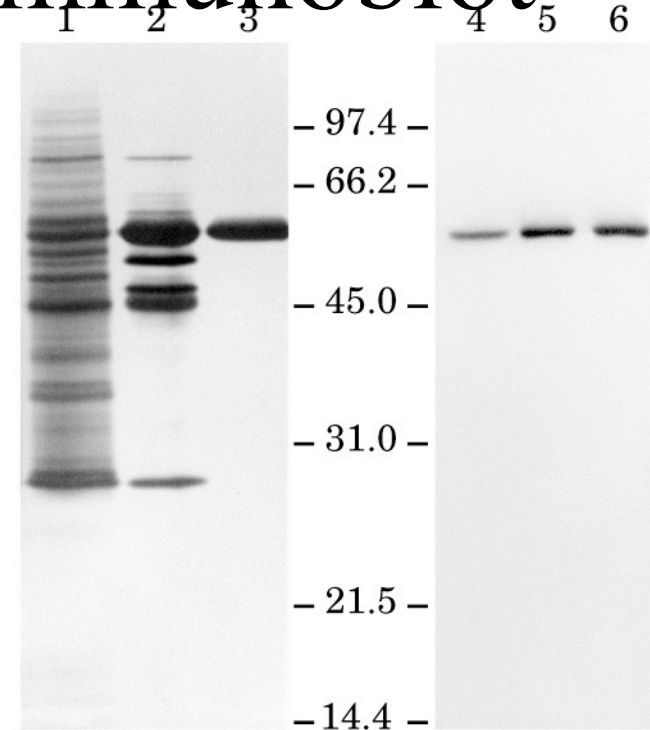
(a)

# ELISA



ELISA assay  
(b)

# immunoblot



SDS gel

(c)

Immunoblot



# Lectine

table 9–3

## Lectins and the Oligosaccharide Ligands That They Bind

| Lectin family and lectin                   | Abbreviation | Ligand(s)                                                               |
|--------------------------------------------|--------------|-------------------------------------------------------------------------|
| <b>Plant</b>                               |              |                                                                         |
| Concanavalin A                             | ConA         | Man $\alpha$ 1—OCH <sub>3</sub>                                         |
| <i>Griffonia simplicifolia</i><br>lectin 4 | GS4          | Lewis b (Le <sup>b</sup> ) tetrasaccharide                              |
| Wheat germ agglutinin                      | WGA          | Neu5Ac( $\alpha$ 2→3)Gal( $\beta$ 1→4)Glc<br>GlcNAc( $\beta$ 1→4)GlcNAc |
| Ricin                                      |              | Gal( $\beta$ 1→4)Glc                                                    |
| <b>Animal</b>                              |              |                                                                         |
| Galectin-1                                 |              | Gal( $\beta$ 1→4)Glc                                                    |
| Mannose-binding protein A                  | MBP-A        | High-mannose octasaccharide                                             |
| <b>Viral</b>                               |              |                                                                         |
| Influenza virus hemagglutinin              | HA           | Neu5Ac( $\alpha$ 2→6)Gal( $\beta$ 1→4)Glc                               |
| Polyoma virus protein 1                    | VP1          | Neu5Ac( $\alpha$ 2→3)Gal( $\beta$ 1→4)Glc                               |
| <b>Bacterial</b>                           |              |                                                                         |
| Enterotoxin                                | LT           | Gal                                                                     |
| Cholera toxin                              | CT           | GM1 pentasaccharide                                                     |

**Source:** Weiss, W.I. & Drickamer, K. (1996) Structural basis of lectin-carbohydrate recognition. *Annu. Rev. Biochem.* **65**, 441–473.



# Selectine (lectine d membrana)

