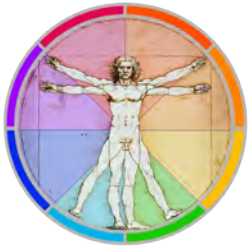
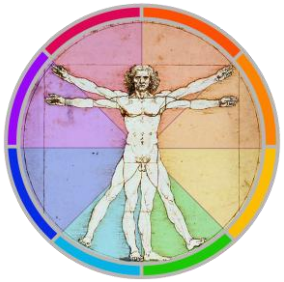
HUBS191 Lecture Material

This pre-lecture material is to help you prepare for the lecture and to assist your note-taking within the lecture, it is NOT a substitute for the lecture !



Please note that although every effort is made to ensure this pre-lecture material corresponds to the live-lecture there may be differences / additions.



HUBS191
Lecture 36

B cells and antibody

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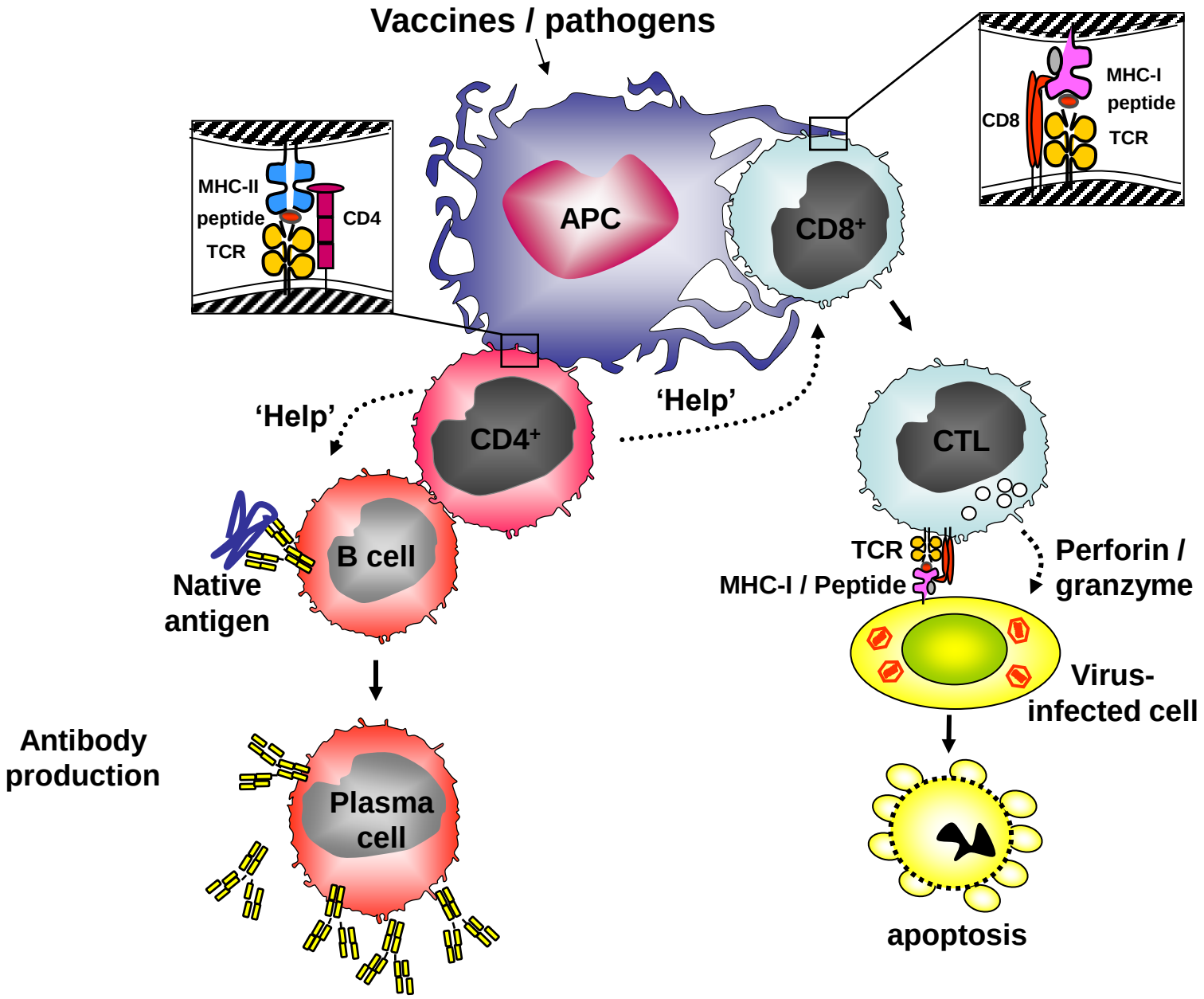
NEW ZEALAND

MICROBIOLOGY & IMMUNOLOGY
Te Tari Moromoroiti me te Ārai Mate

Objectives

- Know that B cells produce antibody
- Understand the role of antibody in the immune system (neutralization, opsonization and complement activation)
- Know the roles of the different classes of antibody (IgG, IgM, IgA & IgE)
- Appreciate the difference between primary and secondary immune responses
- Pre-reading: Marieb; p806-811


Vaccines / pathogens
MHC-II
peptide
TCR
CD4
APC
CD8+
MHC-I
peptide
TCR
CD8
'Help'
'Help'
CD4+
CTL
B cell
Native
antigen
TCR
MHC-I / Peptide
Perforin /
granzyme
Virus-
infected cell
Antibody
production
Plasma
cell
apoptosis

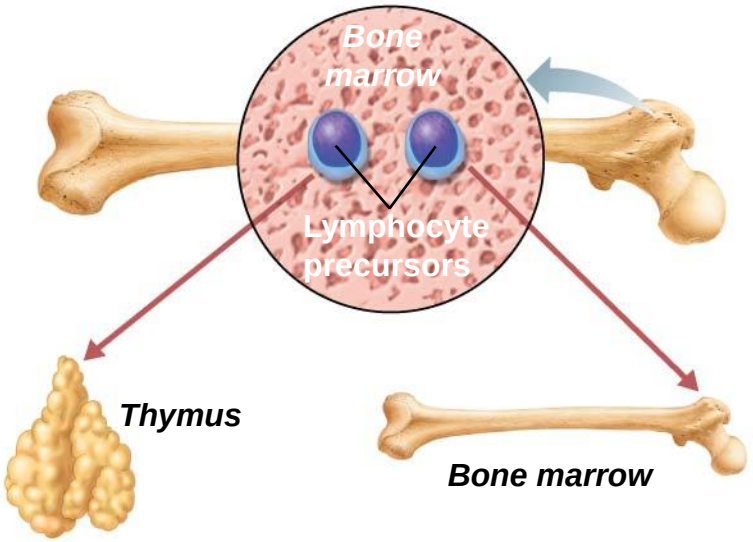
B cells

- Are lymphocytes that develop in the bone marrow
- Express unique antigen receptors (BCR or secreted antibody)
- *Plasma cells* are activated B cells that secrete antibody
- *Memory B cells* provide ‘memory’

Adaptive defenses → Humoral immunity
Adaptive defenses → Cellular immunity

Primary lymphoid organs
(red bone marrow and thymus)

Secondary lymphoid organs
(lymph nodes, spleen, etc.)

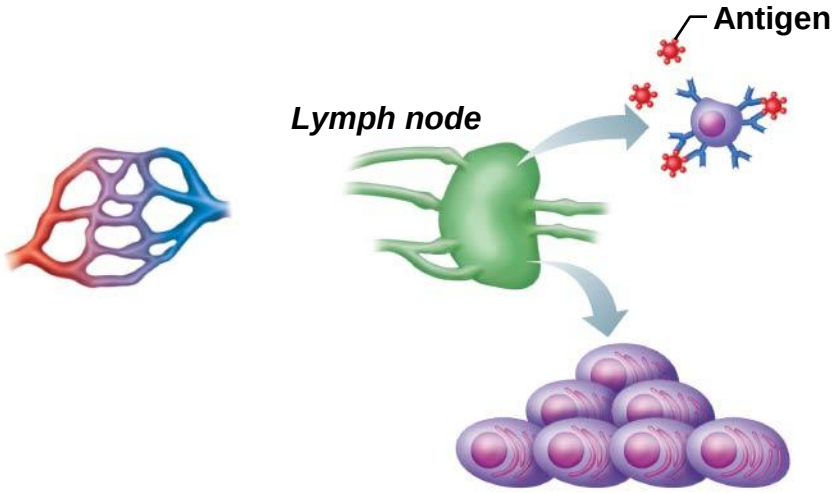


1 Origin

- Both B and T lymphocyte precursors originate in red bone marrow.

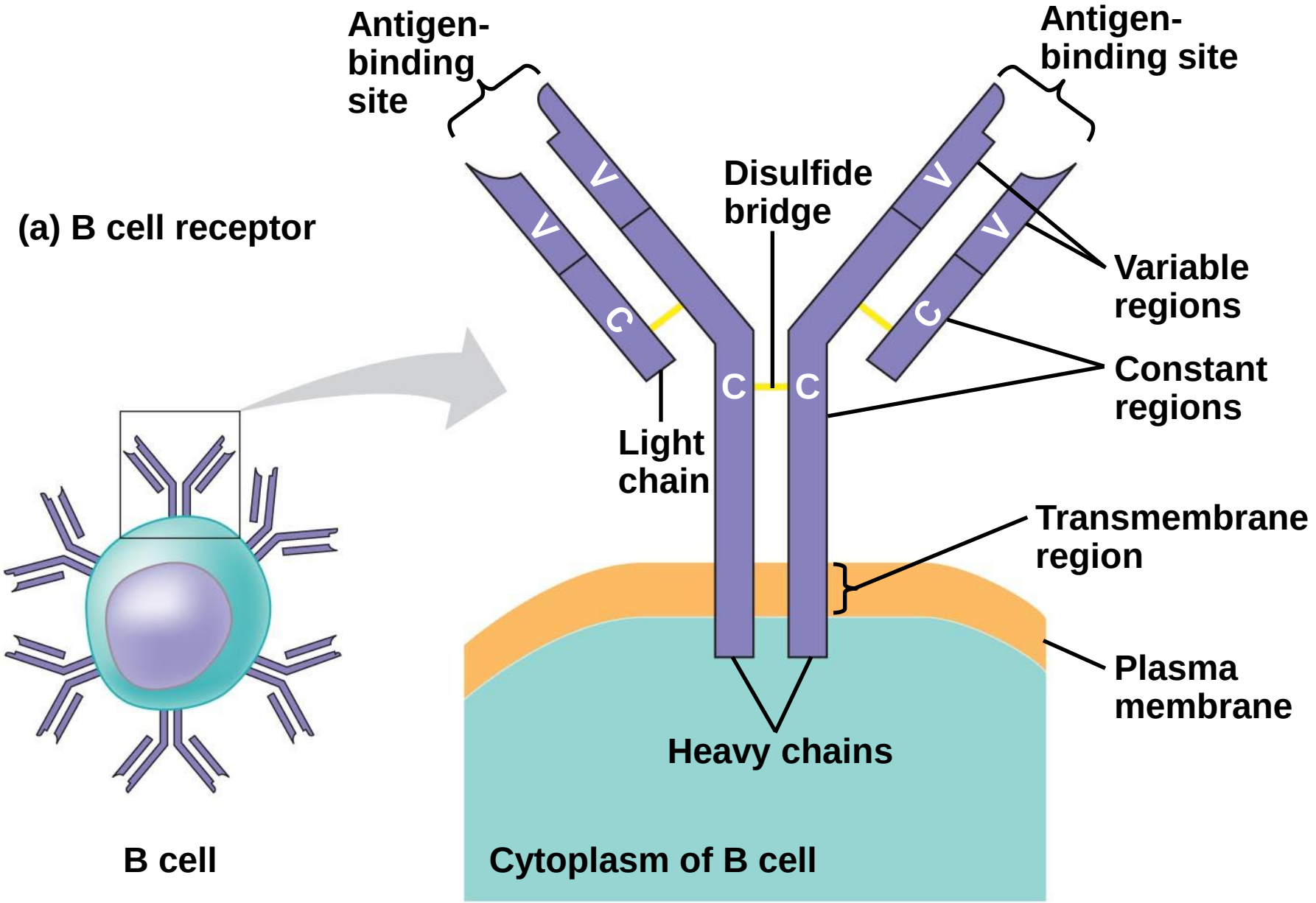
2 Maturation

- Lymphocyte precursors destined to become T cells migrate (in blood) to the thymus and mature there.
- B cells mature in the bone marrow.
- During maturation lymphocytes develop immunocompetence and self-tolerance.



Marieb Figure 21.8 Lymphocyte development, maturation, and activation.

Fig. 43-9a



B cell receptor (BCR)

- The surface of each B cell is covered with ~100,000 BCR (mainly IgM / IgD antibodies).

- The BCR binds antigen and activates the B cell.

- BCR is membrane anchored via a transmembrane domain (TM). Secreted antibodies lack a TM

Three functions of antibody

1. Neutralisation

2. Opsonisation (‘to make tasty to phagocytes’)

3. Complement activation

Fig. 43-21a

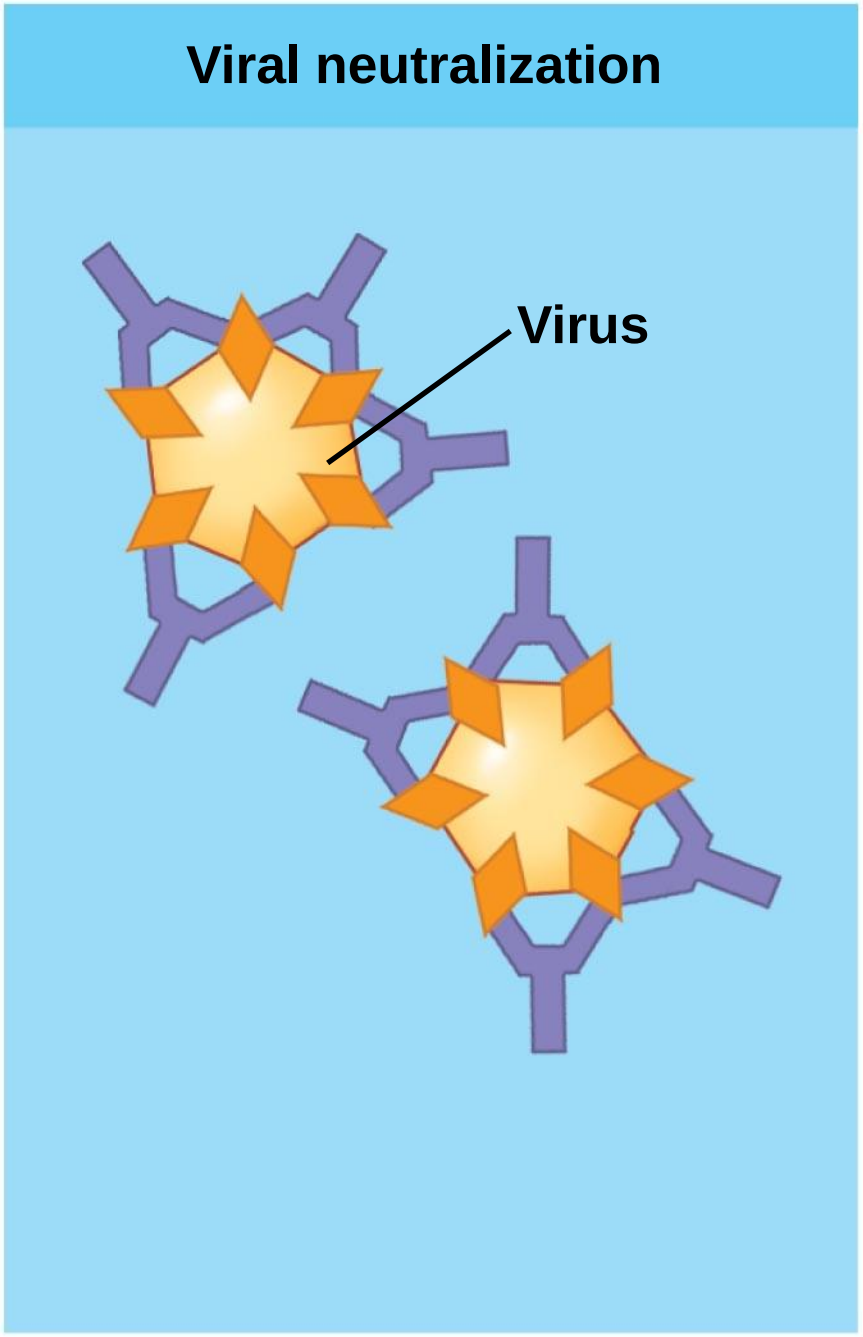


Fig. 43-21b

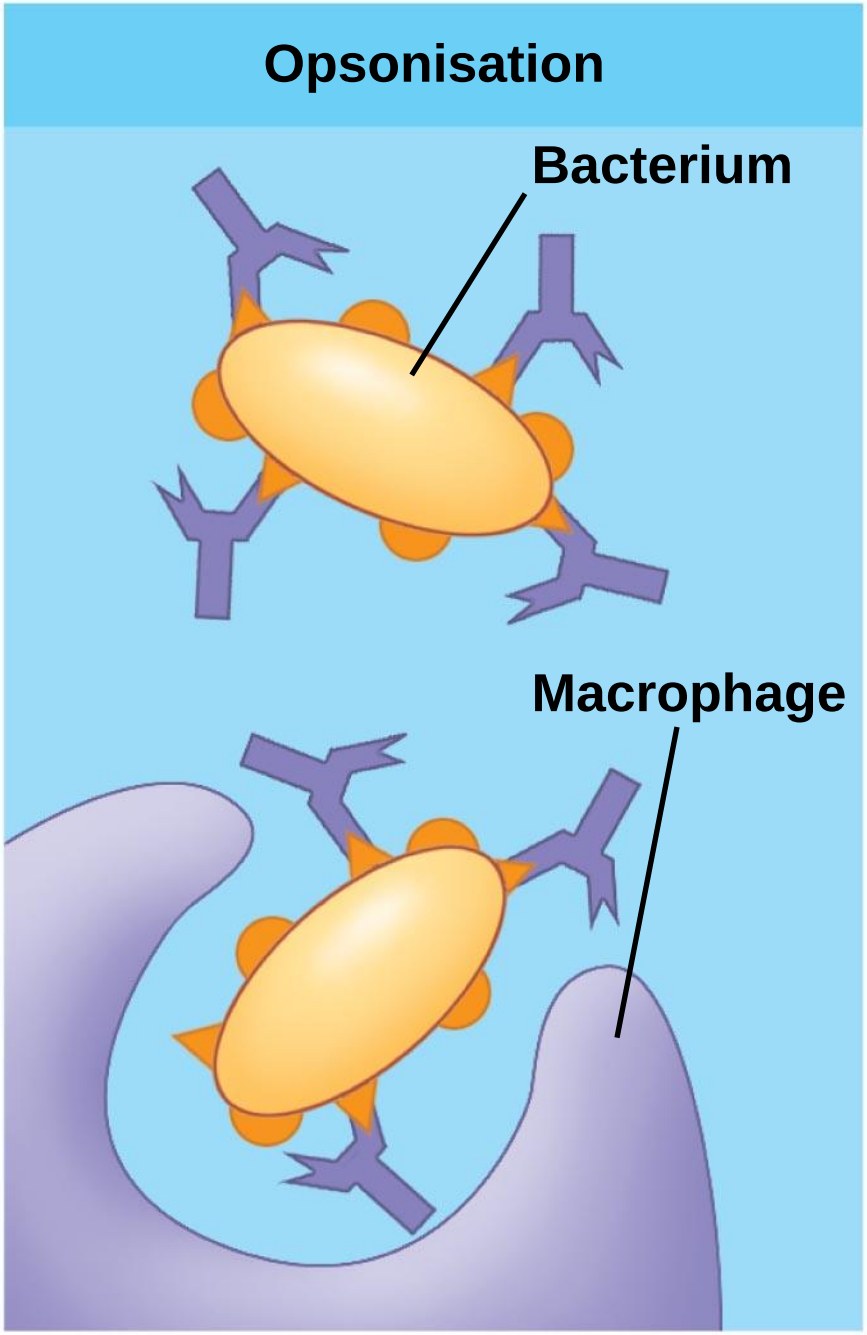
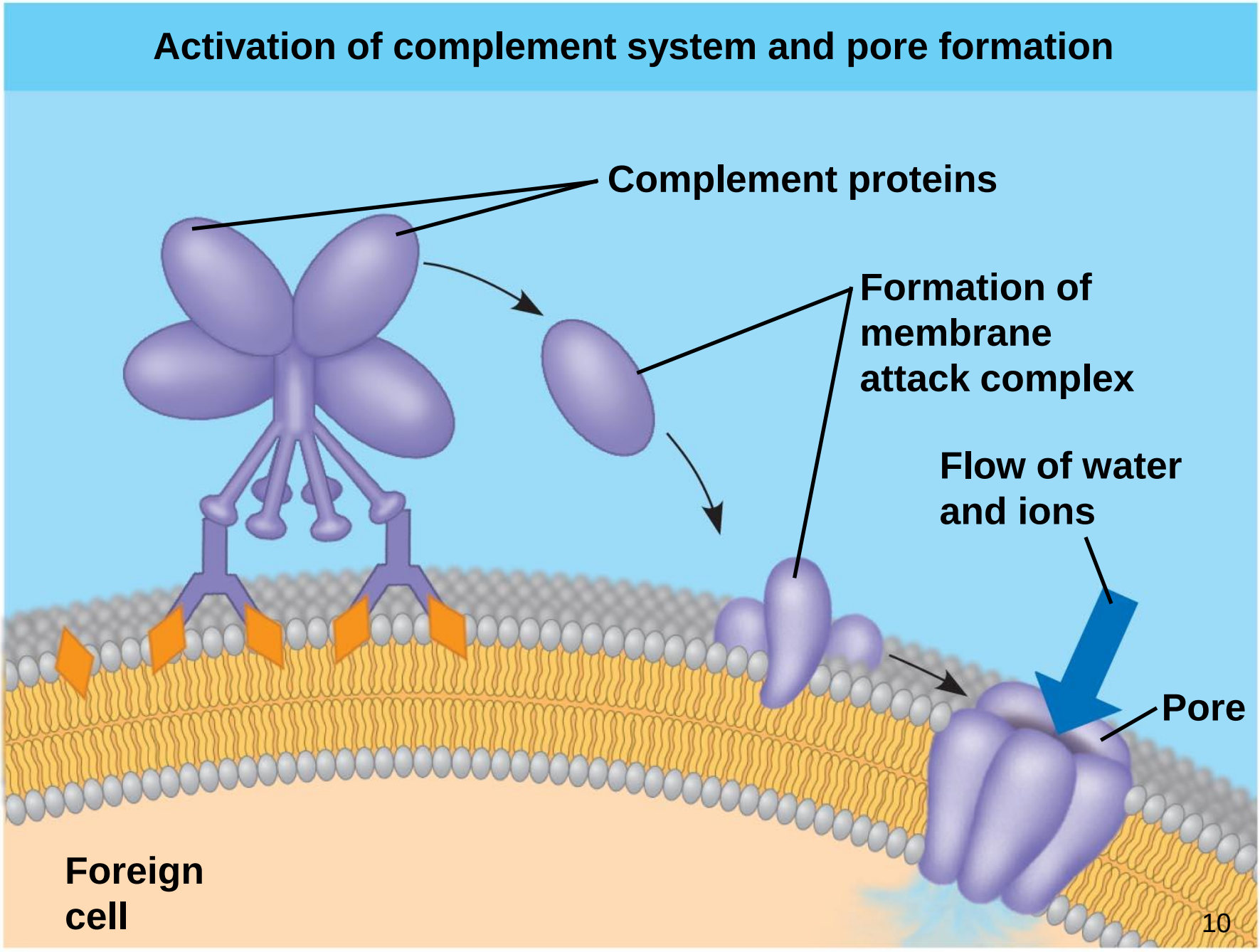
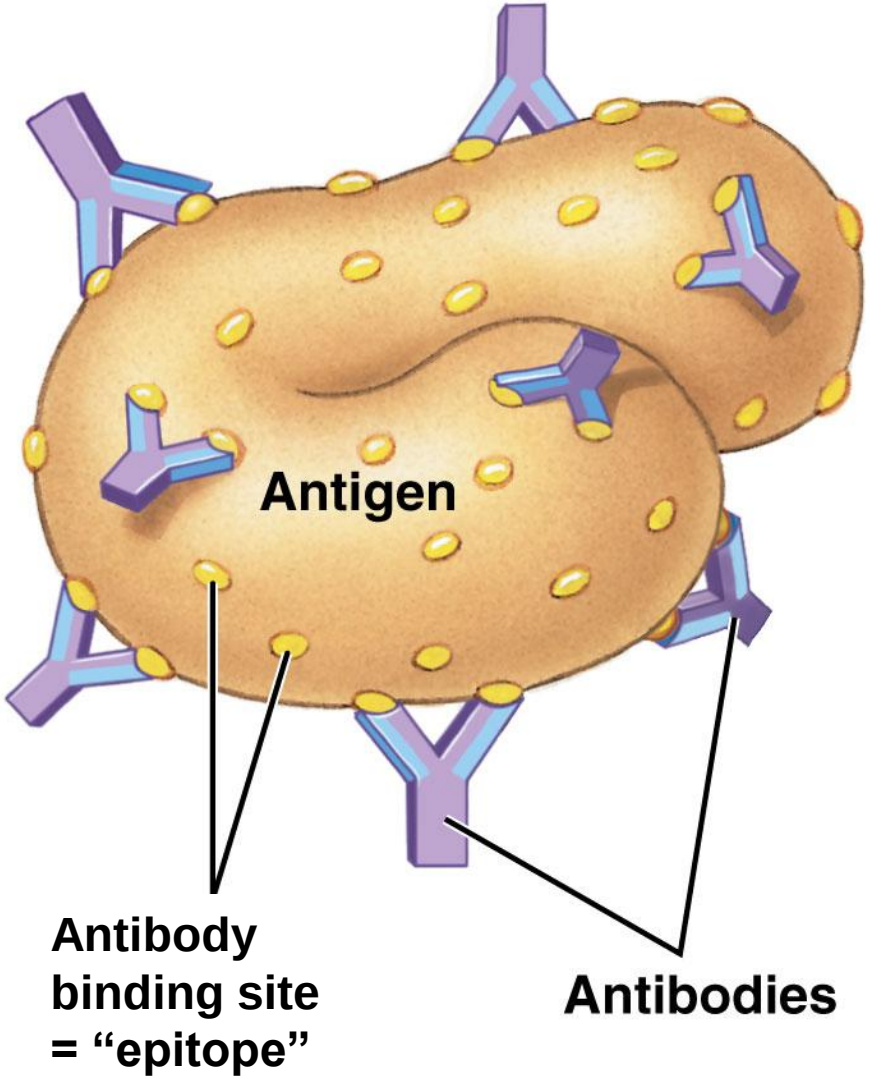


Fig. 43-21c



Antibodies binding to defined regions (antibody binding sites) on a larger structure



Antibodies bind native antigens. Several different antibodies may target a single type of microbe.

The term native antigen means that the antigen does not have to be processed to peptide (or in context of MHC).

Antibodies can recognise just about any structure!

Fig. 43-20b

Class of Immuno-globulin (Antibody)	Distribution	Function
IgG (monomer) 	Most abundant Ig class in blood.	Opsonises / Neutralises Only Ig class that crosses placenta: provides 'passive Immunity' Targets virus / bacteria

Fig. 43-20c

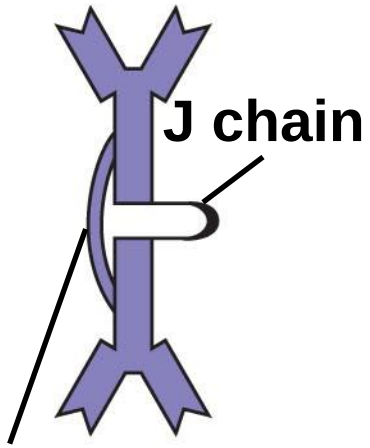
Class of Immuno-globulin (Antibody)	Distribution	Function
IgA (dimer)  	Present in secretions such as tears, saliva, mucus, and breast milk Monomeric form in blood	Defence of mucous membranes, esp. gut Present in breast milk. Confers ‘passive immunity’ on nursing infant Targets virus / bacteria

Fig. 43-22

‘Passive Immunity’

IgA in milk transferred to infant

Fig. 43-20a

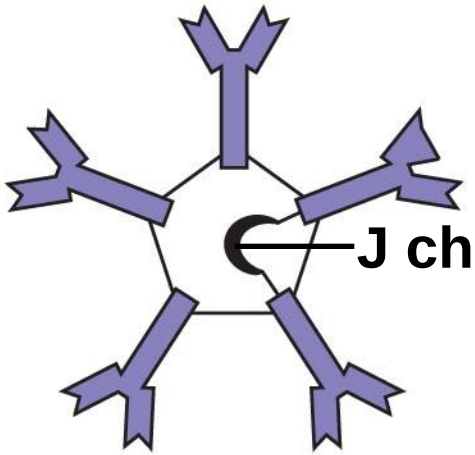
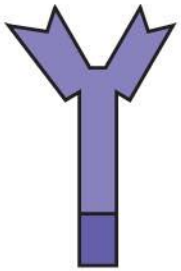
Class of Immuno-globulin (Antibody)	Distribution	Function
IgM (pentamer) 	First Ig class produced after initial exposure to antigen. Expressed on naïve B cells	Very effective in activating Complement Targets extracellular bacteria Acts as antigen receptor (BCR)

Fig. 43-20d

Class of Immuno-globulin (Antibody)	Distribution	Function
IgE (monomer) 	Present in blood at low concen-trations	Immunity to multicellular parasites Allergic reactions (e.g. to pollen or penicillin)

IgE activates **mast cells** for parasite immunity and the allergic response

Fig. 43-20e

Class of Immuno-globulin (Antibody)	Distribution	Function
IgD (monomer) 	Expressed on naïve B cells	Together with IgM, acts as antigen receptor (BCR) Specific function unknown

Memory responses

- Stimulation of B cells by antigen + T cell leads to formation of *plasma cells*.

- In addition, a small number of stimulated B cells form a pool of *memory cells*.

Memory cells

- Memory cells persist for years in blood and lymphatic tissue.
- Express antibody as BCR, but do not secrete antibody.
- Respond rapidly to antigen encounter and become plasma cells.

Primary immune responses

- Takes around 7-14 days before sufficient antibody is produced to eliminate pathogen.

- Relatively low amount of antibody produced – mainly IgM.

Secondary immune responses

- Basis of the success of vaccination.
- Relies on memory B cells.
- Fast: 2-3 days, sufficient antibody is produced to eliminate pathogen - mainly IgG, with additional class switching to IgA and IgE (low levels)

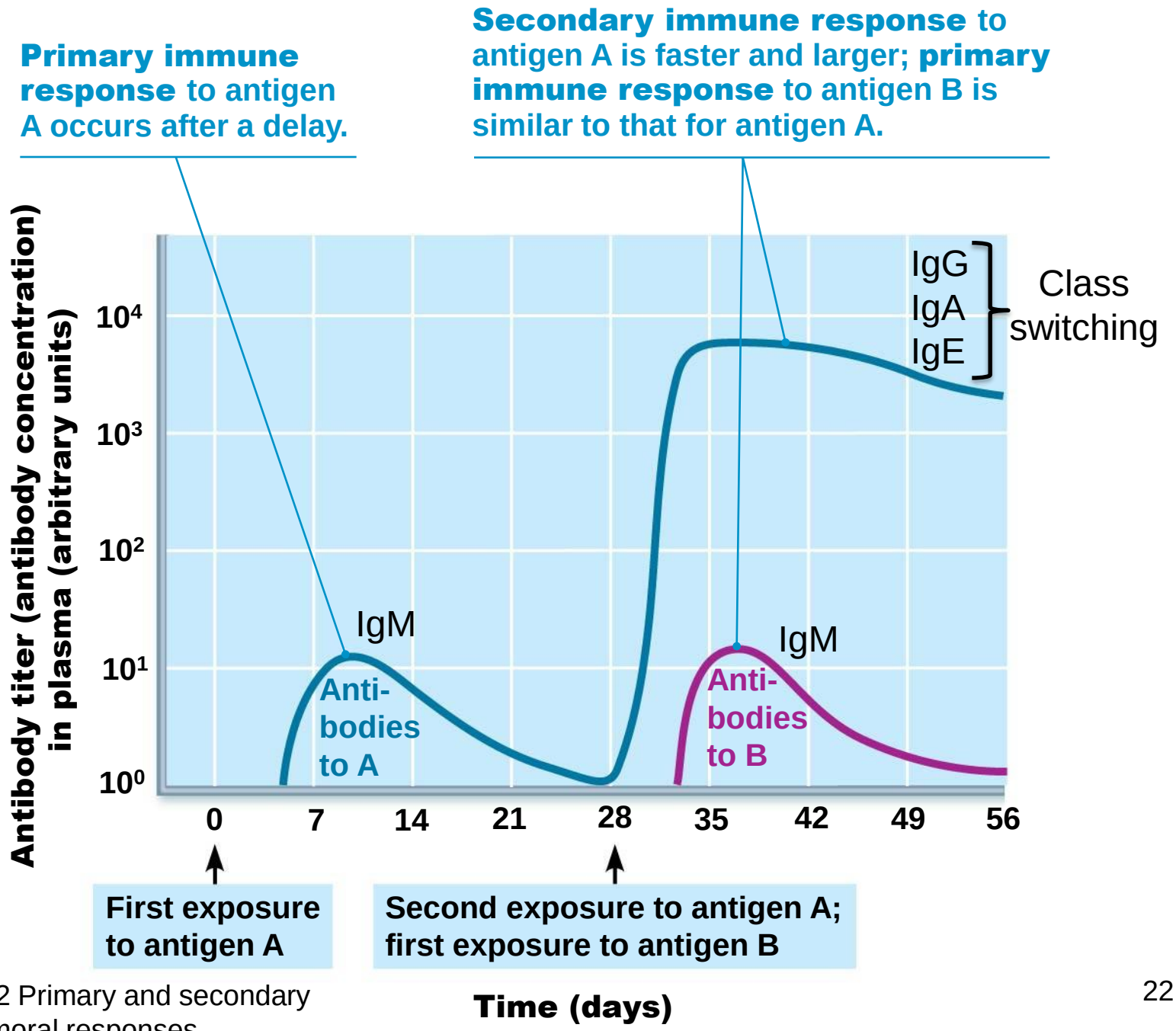


Figure 21.12 Primary and secondary humoral responses.

The basic antibody unit is composed of:

(A) 2 identical heavy and 2 identical light chains.

(B) 2 identical heavy and 2 different light chains.

(C) 2 different heavy and 2 identical light chains.

(D) 2 different heavy and 2 different light chains.

(E) Non-covalently bound heavy and light chains.

The antibodies important in providing passive immunity to infants are:

A) IgD + IgM

B) IgG + IgA

C) IgA + IgE

D) IgD + IgA

The antibody responsible for allergy is:

A) IgD
B) IgG
C) IgA
D) IgE
E) IgM

The first antibody secreted after initial antigen exposure is:

A) IgD
B) IgG
C) IgA
D) IgE
E) IgM

The antibody that most effectively activates the complement system is:

A) IgD
B) IgG
C) IgA
D) IgE
E) IgM

The antibody that most effectively destroys multicellular parasites is:

A) IgD
B) IgG
C) IgA
D) IgE
E) IgM

The BCR on naïve B cells is mainly composed of:

A) IgE and IgG
B) IgG and IgA
C) IgA and IgE
D) IgD and IgM
E) IgM and IgG

IgD:

A) Is pentameric
B) has a J-chain
C) is present as a cell surface receptor
D) is often present in myelomas (plasma cell cancer)
E) is abundant in milk

The process of coating a microbe in antibody (or complement) is called:

A) Alliteration
B) Procrastination
C) Opsonisation
D) Pontification
E) Saponification

B cells recognise ____ via their _____, while T cells recognise _____ in the context of _____:

A) peptides / BCR / native antigens / BCR
B) peptides / TCR / native antigens / MHC
C) antibody / BCR / native antigens / MHC
D) native antigens / BCR / peptides / TCR
E) native antigens / BCR / peptides / MHC

The primary immune response is characterised by the production of predominantly _____ .

A) IgG

B) IgM

C) IgA

D) IgD

E) IgE

The most abundant Ab isotype produced during the secondary immune response is:

A) IgG
B) IgM
C) IgA
D) IgD
E) IgE

The secondary immune response:

A) Takes 7- 14 days to develop

B) Takes 2-3 days to develop

An individual is exposed to antigen **A**. Six months later the same individual is exposed to both antigens **A** and **B.** After the second exposure, the individual would:

A) make a primary response to **A** and a secondary response to **B**

B) make a secondary response to both **A** and **B**

C) make a secondary response to **A** and a primary response to **B**

Memory B cells:

A) Express the BCR, but do not secrete antibody
B) Do not express the BCR, but secrete antibody
C) Help other B cells secrete antibody
D) Are also known as ‘plasma cells’

The following is true of plasma cells

A) can become memory B cells
B) are derived from T cells
C) possess a BCR
D) secrete antibody

Only B cells specific for tetanus toxin (TT) would undergo clonal expansion during an immune response to TT because:

A) They have an antigen-specific TCR

B) They can sense what is dangerous to the body.

C) They bind native TT and present a peptide from TT to Ag-specific $CD4^+$ T cells.

D) They respond to TT by rearranging their B cell receptor DNA

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