

A study material for M.Sc. Biochemistry (Semester: III) Students
on the topic (CC-12; Unit II)

Antigen Related Terminology

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Haptens:

Small, non-biologic molecules that bind to immune cells receptors but cannot by themselves induce a specific immune response.

Example:

Land-Steiner's experiment.

Hapten (2,4-dinitrophenyl-tyrosine) \longrightarrow injected in mice \longrightarrow No immune response.

Carrier (protein) \longrightarrow injected in mice \longrightarrow Positive immune response.

Hapten-Carrier Conjugate \longrightarrow injected in mice \longrightarrow Anti-Hapten, and Anti-Carrier Abs

Differences - Antigens and Haptens

ANTIGENS

Antigens are not conjugating with a carrier molecule.

Antigens are used in *in vitro* techniques such as ELISA and in Pharmacological purposes.

Antigen reactions are Antigenic and Immunogenic.

HAPTENS

Haptens conjugate with carrier molecules.

Haptens are used in Antibiotics and Anesthetics designing.

Hapten reactions are only Immunogenic.

ADJUVANTS

- Adjuvants are substances that, when mixed with an antigen and injected with it, enhance the immunogenicity of that antigen.
- The word Adjuvants was derived from the Latin word "*Adjuvare*" which means "To help").
- Adjuvants are often used to boost the immune response when an antigen has low immunogenicity or when only small amounts of an antigen are available.
- Adjuvants may be added to a Vaccine to modify the Immune response.
- The antibody response of Mice to immunization with Bovine serum albumin (BSA) can be increased fivefold or more if the BSA is administered with an adjuvant.

Tolerogens

- 3 Can bind *and* induce an immune response
- 3 The tolerogen is the target of the response it induces
- 3 Subsequent exposures or a different route of exposure (e.g., oral vs. subcutaneous) results in decreased responsiveness
- 3 Therapeutic potential for:
 - ❖ Allergies
 - ❖ Autoimmunity
 - ❖ Transplants

Mitogens

- A **mitogen** is a chemical substance that encourages a cell to commence **cell division**.
- **B-cell mitogens:** lectin glycoproteins and lipopolysaccharide (LPS)
- **T-cell mitogens:** phytohaemagglutinin (PHA)

Mitogens

Polyclonal activators—induce non-specific division (mitosis) and differentiation

❖ Response not directed at a specific antigen

※ T cells → cytokines

※ B cells → antibodies

❖ LPS (endotoxin)—activates B cells and induces cytokine production by macrophages

※ Can be used to study lymphocyte proliferation

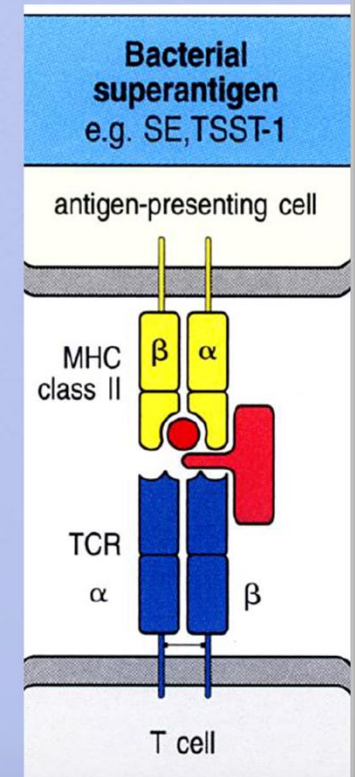
※ Other examples: concanavalin A (conA), phytohemagglutinin (PHA), pokeweed mitogen (PWM)

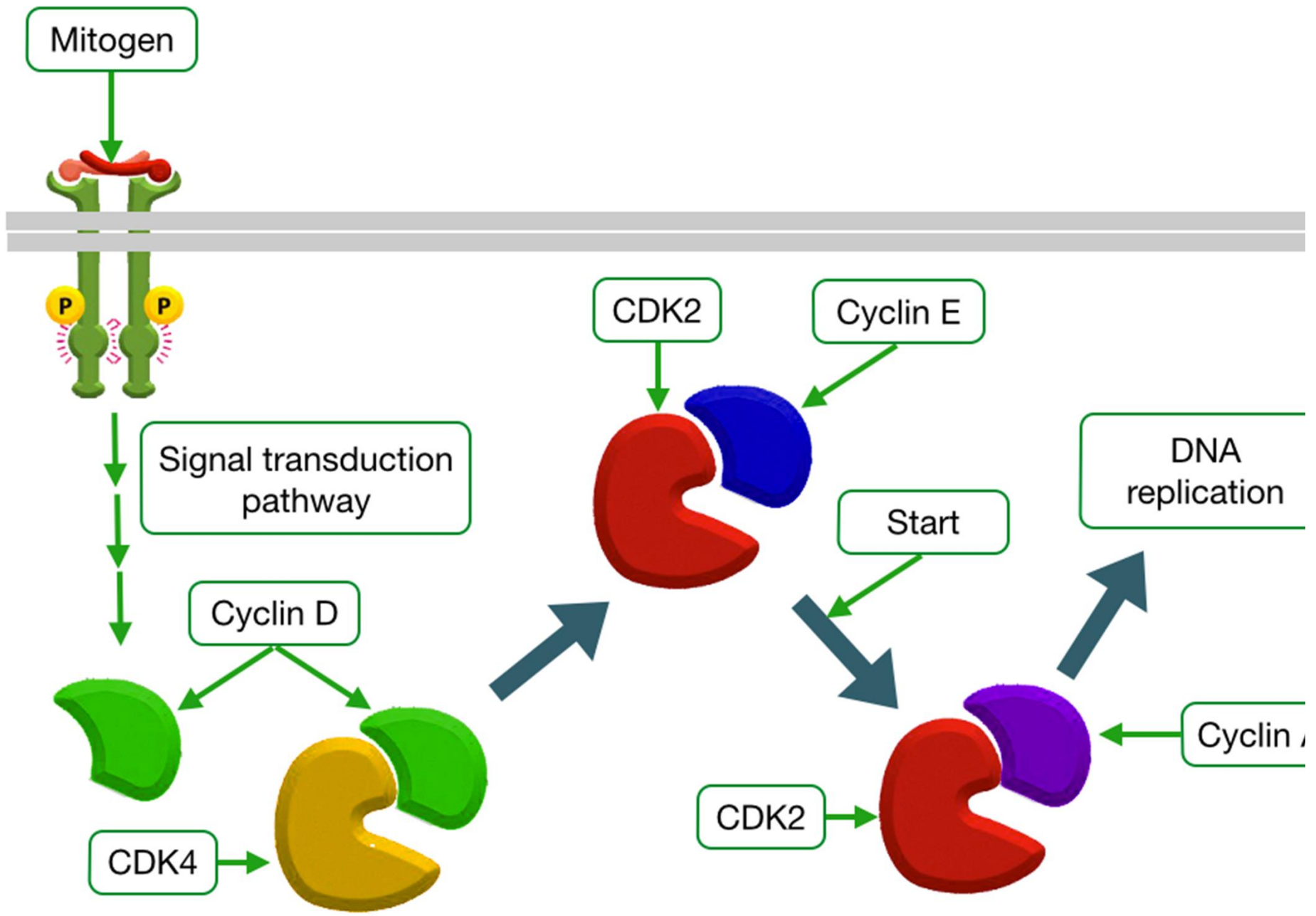
❖ Superantigens (sAg)

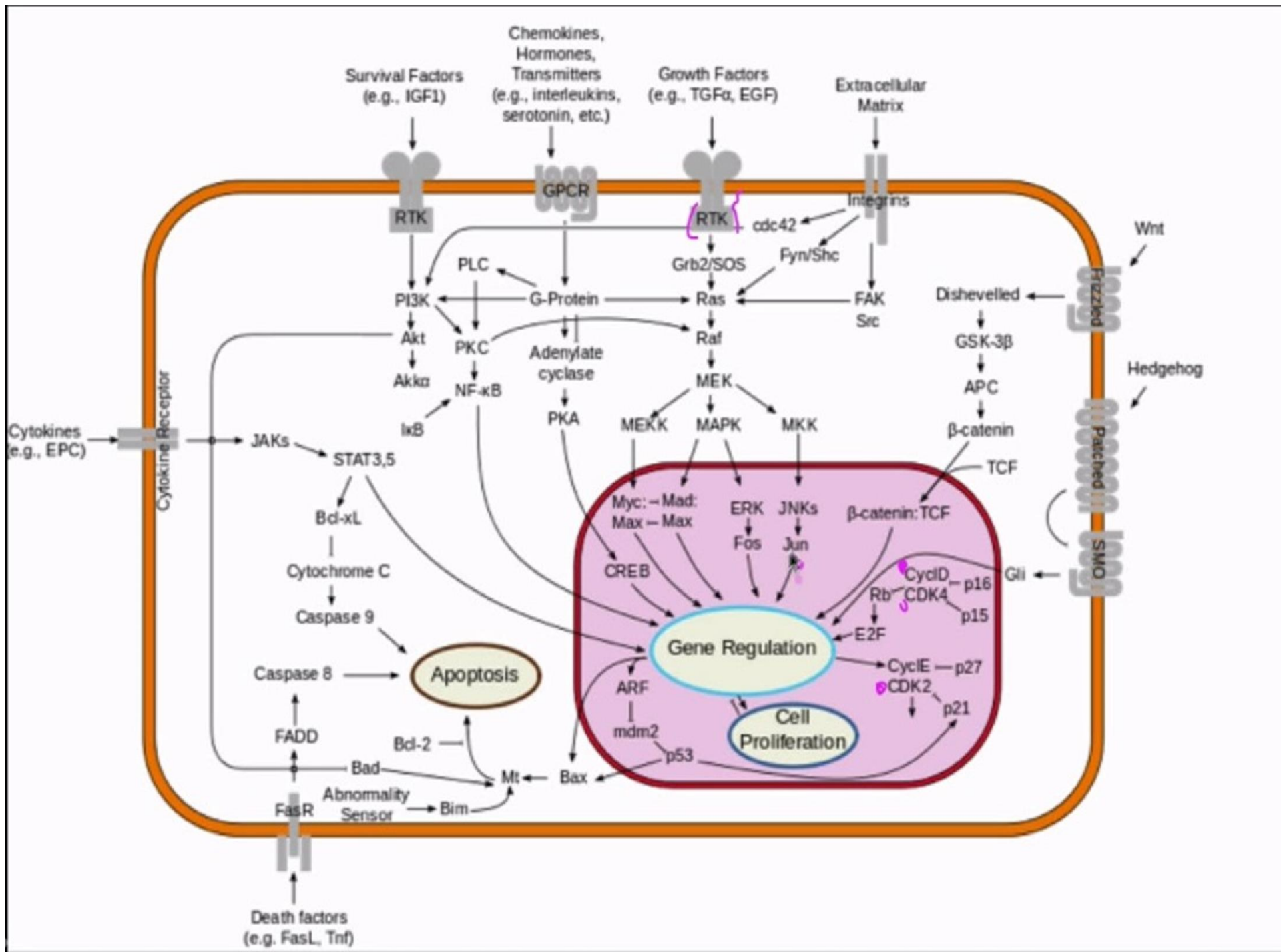
※ Stabilizes TCR:MHC interaction → unregulated cytokine production—“Cytokine storm”

※ Produced by some pathogens

※ Symptoms vary: Fever, rash, organ failure, shock







Superantigens

- Bacterial and viral proteins
 - staphylococcal enterotoxin B
 - the toxin that causes toxic shock syndrome
 - mouse tumor virus superantigen
 - putative proteins from Epstein-Barr and rabies viruses
- Stimulate stronger immune response than normal antigens by “tricking” T cells into activation although they have not been triggered by a specific antigen
- Stimulate T cells to proliferate nonspecifically
- Contribute to microbial pathogenicity
- stimulate release of massive quantities of cytokines from T cells
 - may result in circulatory shock and multiorgan failure ¹⁴

Types of superantigens

- **Exogenous SAgs:** soluble proteins secreted by bacteria and variety of exotoxins (e.g. Staphylococcal enterotoxins, Streptococcal pyrogenic exotoxins and TSST)
- **Endogenous SAgs:** cell membrane protein coated certain viruses that infect mammalian cells (e.g. MMTV-associated SAgs)
- **B-cell SAgs:** these SAgs stimulates predominantly B cells. Formation of immune complexes.(e.g.EBV-associated SAgs)

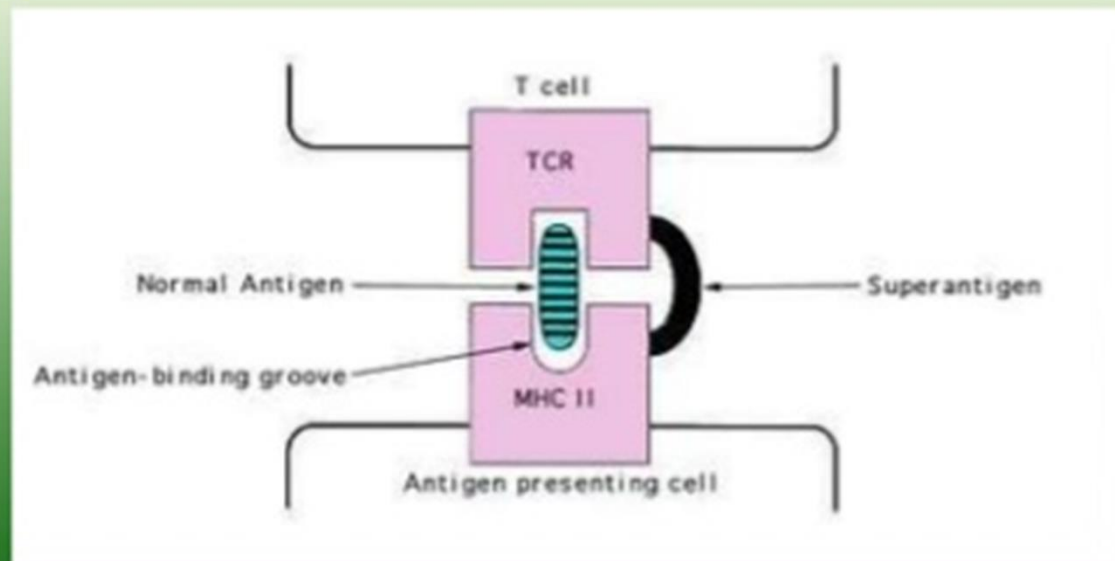
DIFFERENCES

Antigens

- Specific activation of T cells
- Binds to particular epitope on the TCR
- Activate 0.01-0.001% of T cells

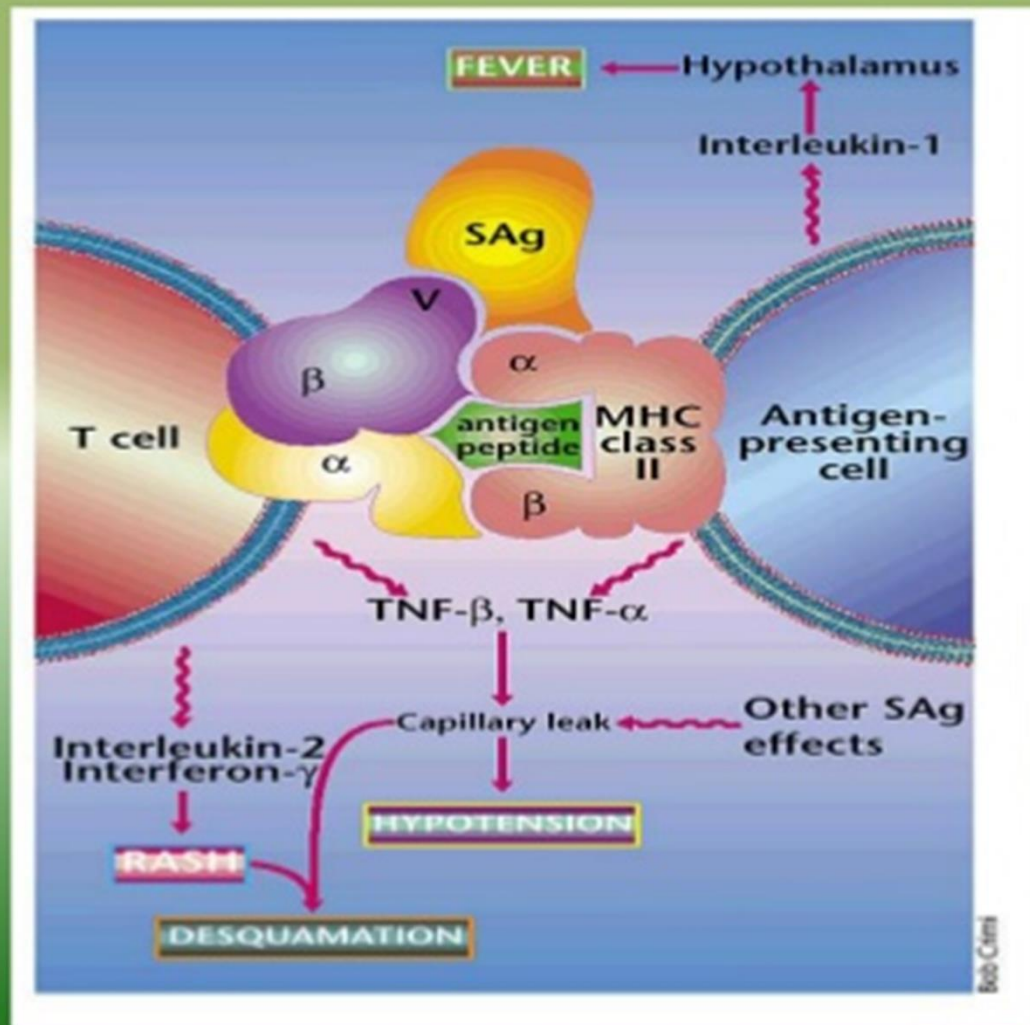
Superantigens

- Non specific activation of T cells
- Binds to V β chain of TCR
- Activate 20-30% of T cells



SIGNIFICANCE

- Direct Effects
 - Inflammatory activity
 - Anergy and Deletion
 - Cytotoxicity
 - Isotype switch
- Indirect Effects
 - Emesis
 - Mitogenic activity
 - Monocytic cell activation



Acknowledgement and Suggested Readings:

1. Kuby Immunology; Sixth Edition; Kindt, Goldsby and Osborne; W. H. Freeman and Company
2. Fundamental Immunology; 5th edition; William E., Md. Paul (Editor) ; Lippincott Williams & Wilkins Publishers
3. Roitt's Essential Immunology; Tenth Edition; Roitt and Delves; Blackwell Science
4. Cellular and Molecular Immunology; 6th Edition; Abbas, Lichtman and Pillai; Saunders Elsevier

Thanks

