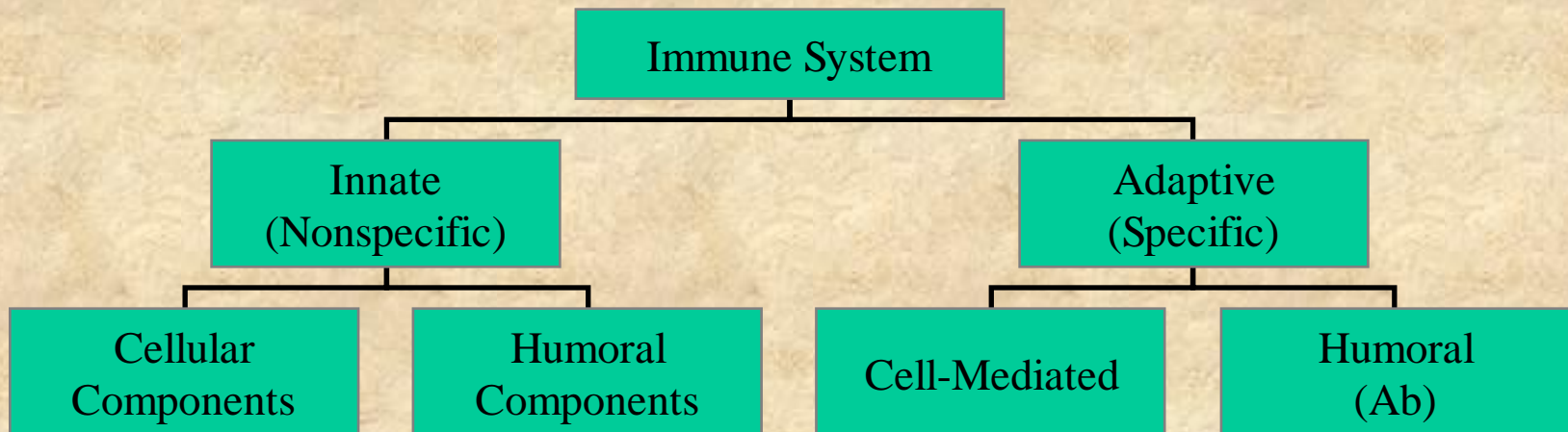


Overview of the Immune System



Antigens

Definitions

- Immunogen
- Antigen (Ag)
- Hapten
- Epitope or Antigenic Determinant
- Antibody (Ab)

Factors Influencing Immunogenicity

Contribution of the Immunogen

- Foreignness
 - Size
 - Chemical Composition
 - Primary Structure
 - Secondary Structure
 - Tertiary Structure
 - Quarternary Structure
- **Sequence determinants**
- } **Conformational determinants**

Factors Influencing Immunogenicity

Contribution of the Immunogen

- Foreignness
- Size
- Chemical Composition
- Physical Form
 - Particulate > Soluble
 - Denatured > Native

Factors Influencing Immunogenicity

Contribution of the Immunogen

- Foreignness
- Size
- Chemical Composition
- Physical Form
- Degradability
 - Ag processing by Ag Presenting Cells (APC)

Factors Influencing Immunogenicity

Contribution of the Biological System

- Genetics
 - Species
 - Individual
 - Responders vs Non-responders
- Age

Factors Influencing Immunogenicity

Method of Administration

- Dose
- Route
 - Subcutaneous > Intravenous > Intragastric
- Adjuvant
 - Substances that enhance an immune response to an Ag

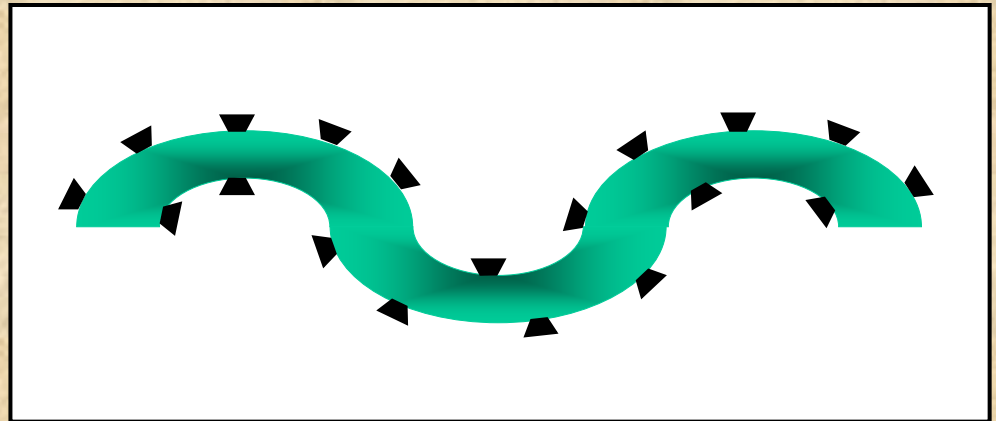
Chemical Nature of Immunogens

- Proteins
- Polysaccharides
- Nucleic Acids
- Lipids
 - Some glycolipids and phospholipids can be immunogenic for T cells and illicit a cell mediated immune response

Types of Antigens

T-independent

- Polysaccharides
- Properties
 - Polymeric structure
 - Polyclonal B cell activation
 - **Yes - Type 1 (TI-1)**
 - **No - Type 2 (TI-2)**
 - Resistance to degradation

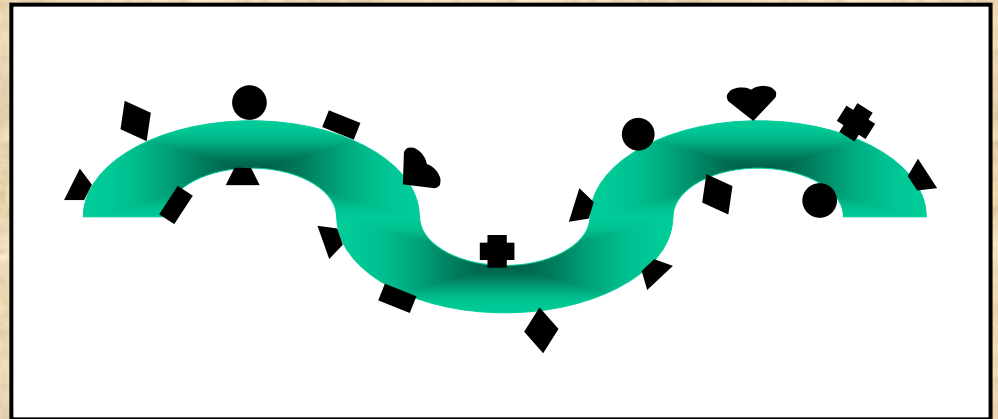


- Examples
 - Pneumococcal polysaccharide, lipopolysaccharide
 - Flagella

Types of Antigens

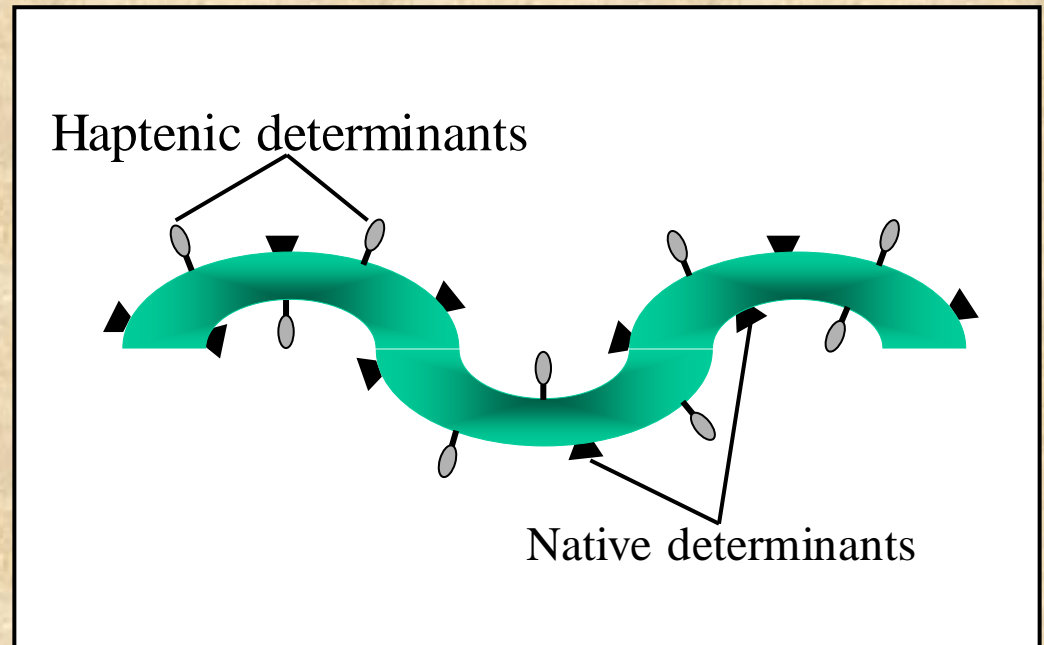
T-dependent

- Proteins
- Structure
- Examples
 - Microbial proteins
 - Non-self or Altered-self proteins



Hapten-carrier conjugates

- Definition
- Structure
 - native determinants
 - haptenic determinants

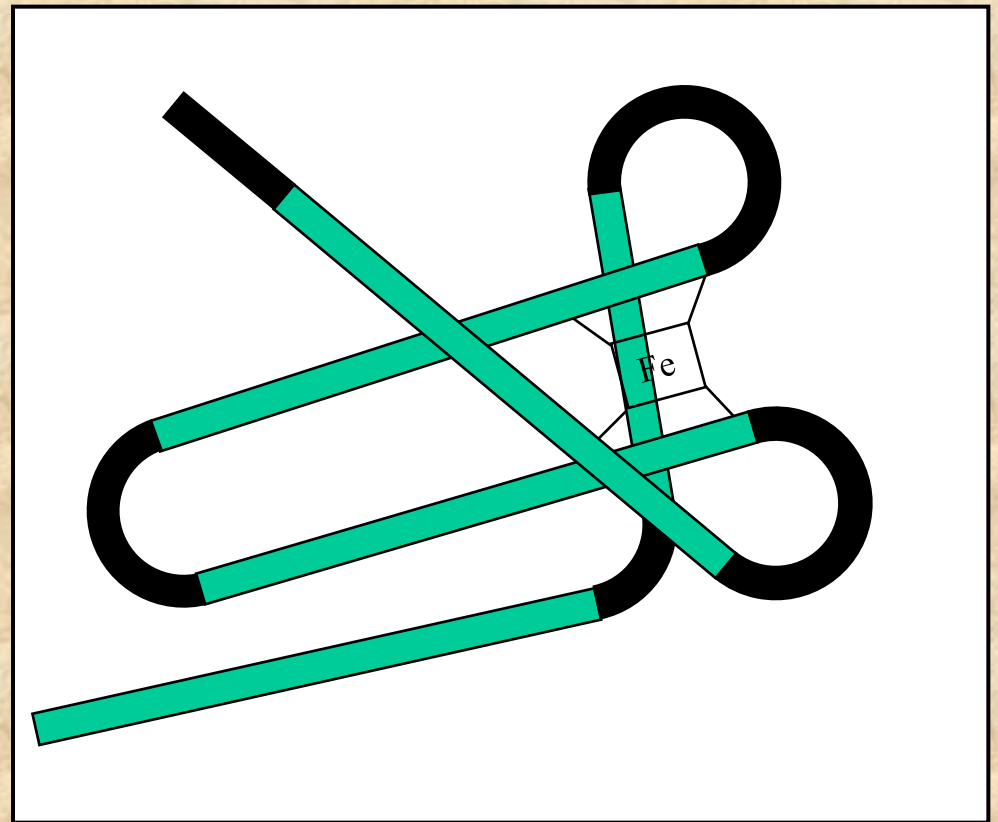


Antigenic Determinants Recognized by B cells and Ab

- **Composition**
 - Proteins, polysaccharides, nucleic acids, haptens
 - Sequence (linear) determinants
 - Conformational determinants
- **Size**
 - 4-8 residues

Antigenic Determinants Recognized by B cells and Ab

- Composition
- Size
- Number
 - Limited
(immunodominant epitopes)
 - Located on the external surfaces of the Ag



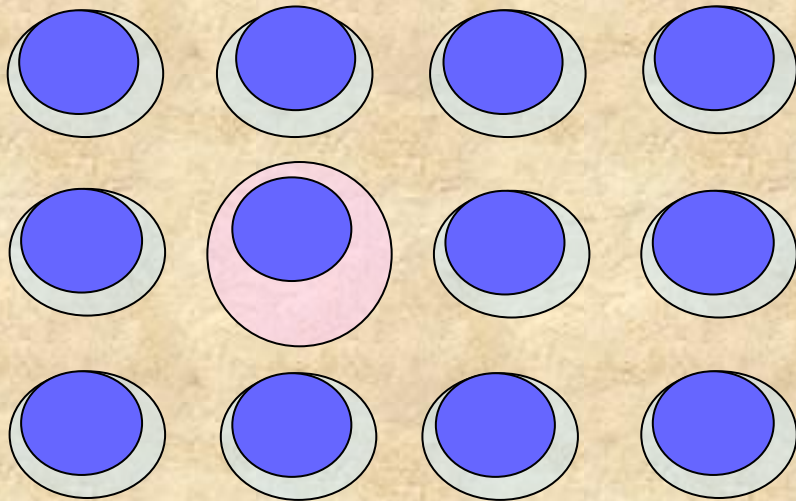
Antigenic Determinants Recognized by T cells

- Composition
 - Proteins (some lipids)
 - Sequence determinants
 - Processed
 - MHC presentation (lipid presentation by MHC-like CD1)
- Size
 - 8 -15 residues
- Number
 - Limited to those that can bind to MHC

Superantigens

- Definition

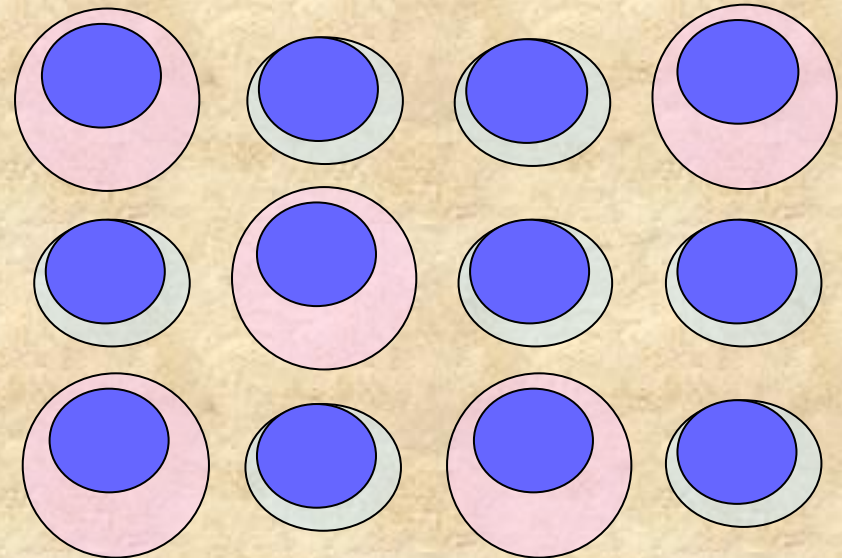
Conventional Antigen



Monoclonal/Oligoclonal
T cell response

$1:10^4 - 1:10^5$

Superantigen



Polyclonal T cell response

1:4 - 1:10

Superantigens

- Definition
- Examples
 - Staphylococcal enterotoxins
 - Staphylococcal toxic shock toxin
 - Staphylococcal exfoliating toxin
 - Streptococcal pyrogenic exotoxins

Determinants Recognized by the Innate Immune System

- Adaptive Immune System – Discrete Determinants
 - Reacts with a specific pathogen
- Innate Immune System – Broad Molecular Patterns
 - Reacts with a variety of pathogens

Determinants Recognized by the Innate Immune System

- PAMPs – Pathogen Associated Molecular Patterns
- PRRs – Pattern Recognition Receptors

PAMP	PRR	Biological Consequence of Interaction
Microbial cell wall components	Complement	Opsonization; Complement activation
Mannose-containing carbohydrates	Mannose-binding protein	Opsonization; Complement activation
Polyanions	Scavenger receptors	Phagocytosis
Lipoproteins of Gram ⁺ bacteria Yeast cell wall components	TLR-2 (Toll-like receptor 2)	Macrophage activation; Secretion of inflammatory cytokines

PAMP	PRR	Biological Consequence of Interaction
Double stranded RNA	TLR-3	Production of interferon (antiviral)
LPS (lipopolysaccharide of Gram ⁻ bacteria)	TLR-4	Macrophage activation; Secretion of inflammatory cytokines
Flagellin (bacterial flagella)	TLR-5	Macrophage activation; Secretion of inflammatory cytokines

PAMP	PRR	Biological Consequence of Interaction
U-rich single stranded viral RNA	TLR-7	Production of interferon (antiviral)
CpG containing DNA	TLR-9	Macrophage activation; Secretion of inflammatory cytokines

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