

Amino acid synthesis

- Many microorganisms can synthesize all 20 aa's
- Humans cannot make 9 of them (essential amino acids)
 - Non-essential aa's synthesized by simple reactions
 - Alanine synthesized in single step from pyruvate
 - Aspartate synthesized in single step from oxaloacetate
 - Pathways for essential aa's are complex
 - Essential aa's require 5-16 steps

TABLE 24.1 Basic set of 20 amino acids

Nonessential	Essential
Alanine	Histidine
Arginine	Isoleucine
Asparagine	Leucine
Aspartate	Lysine
Cysteine	Methionine
Glutamate	Phenylalanine
Glutamine	Threonine
Glycine	Tryptophan
Proline	Valine
Serine	
Tyrosine	

Biochemistry 5th ed. Berg et al. Freeman

PDF of chapter located on the Media Disk

Chapter 25:

The Adaptive Immune System

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- T cells
 - Develop in the thymus
- B cells
 - Develop in the bone marrow

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- Clonal selection
 - B cells make > 10¹² different antibodies

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- Antigenic determinants (epitopes)
 - Stimulate antibody production
- Polyclonal
 - antigens which have a variety of sites recognized by different B-cell clones
- Monoclonal
 - Only a single clone is activated
 - Widely used in biotechnology & medicine

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- Memory cells

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- B cells produce antibodies
 - immunoglobulins (Ig)
 - Each with different aa sequence
 - 20% total protein in blood plasma
 - Mammals make 5 classes of Ig's
- Activation of B cells
 - Naïve cell (antigen & T cell)
 - Proliferates into effector cell
 - Secretes antibody
 - At full maturation plasma cell
 - 5000 antibody molecules /sec
 - Most die some survive (memory)

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- Antibody Structure
 - Y shape
 - Two identical antigen binding sites (bivalent)
 - Hinge region
 - Tail region
 - Gives functional properties (different Ig groups)
 - With 3 or more antigenic determinants
 - Cross-link into lattice

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- Antibody structure
 - Four polypeptide chains
 - Two identical light (L) chains
 - 220 aa's
 - Two identical heavy (H) chains
 - 440 aa's
 - Held together by noncovalent and covalent (disulfide) bonds

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- 5 classes of antibodies determined by type of heavy chain (2 more found in higher mammals K λ)
 - IgM (μ)
 - First class made by all developing B cells
 - Insert into plasma membrane (immature naïve B cell)
 - IgD (δ)
 - Cell surface proteins (mature naïve B cell)
 - IgG (γ)
 - Secreted during secondary antibody response
 - Activates other WBC
 - Some pass from mother to fetus and in mothers milk
 - IgA (α)
 - Principal class found in secretions (saliva, tears, milk etc)
 - IgE (ε)
 - Bound to mast cells and basophiles
 - Antigens trigger release of histamine (blood vessels dilate)
 - Allergic reactions

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- Light & heavy chains
 - Variable sequence at N-terminal ends
 - Constant sequence at C-terminal ends

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- Constant region

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- Antibody diversity
 - Before any antigen is present pre-immune system contains 10^{12} different antibodies
 - Humans only have 25,000 genes (not enough for all antibodies)
 - Combine heavy & light variable regions
 - 1000 genes for each = 10^6 different antigen binding sites
 - Genetic mechanism highly variable in mammals
 - Process
 - Before antigen join different gene segments
 - After antigen
 - mutate existing genes to increase affinity for binding site
 - DNA rearrangements change class of antibody made

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- Joining different gene segments
- Light chain includes
 - V regions (40)
 - J (joining) regions (5)
 - C region
- Heavy chain includes
 - V regions (40)
 - D (diversity) regions (25)
 - J (joining) regions (6)
 - C region cluster (Ig types)

light chain NH₂ COOH 14