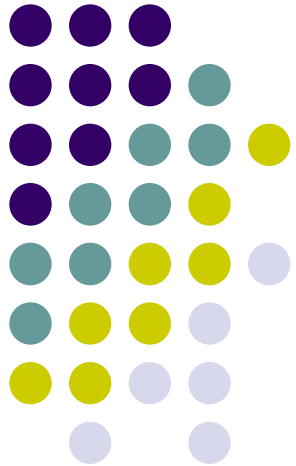
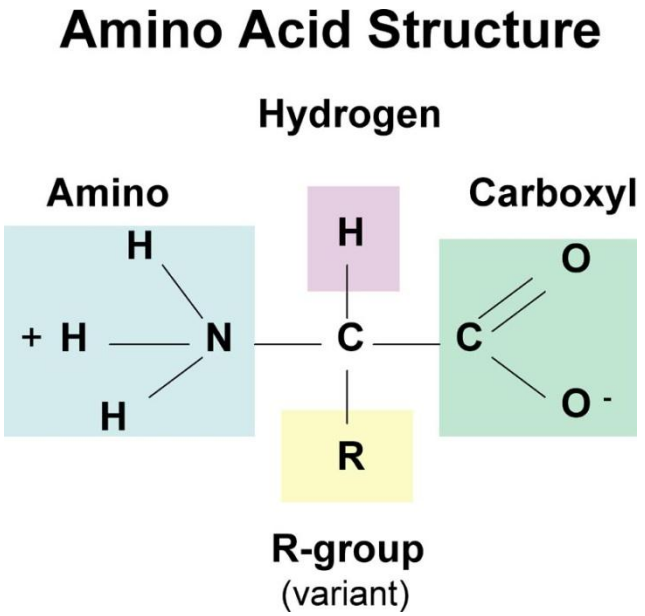
Amino acids
Proteins

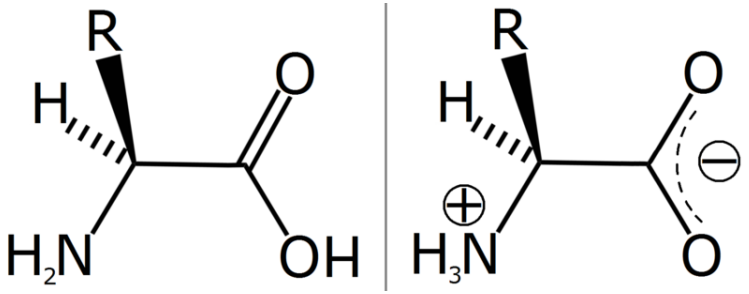
Judit Varga



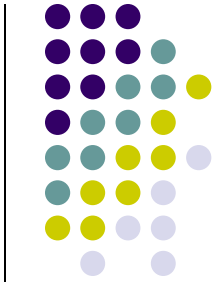
General features of amino acids

- 20 types
- building blocks of proteins
- α amino acids



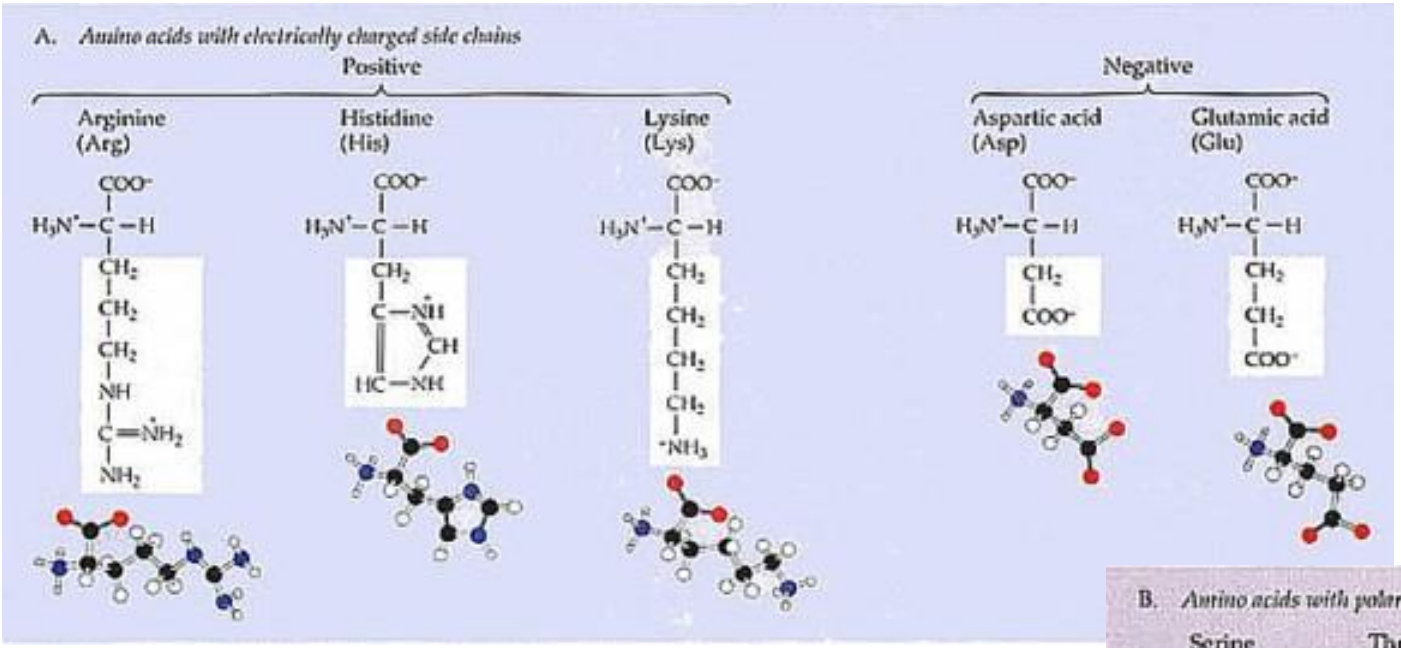


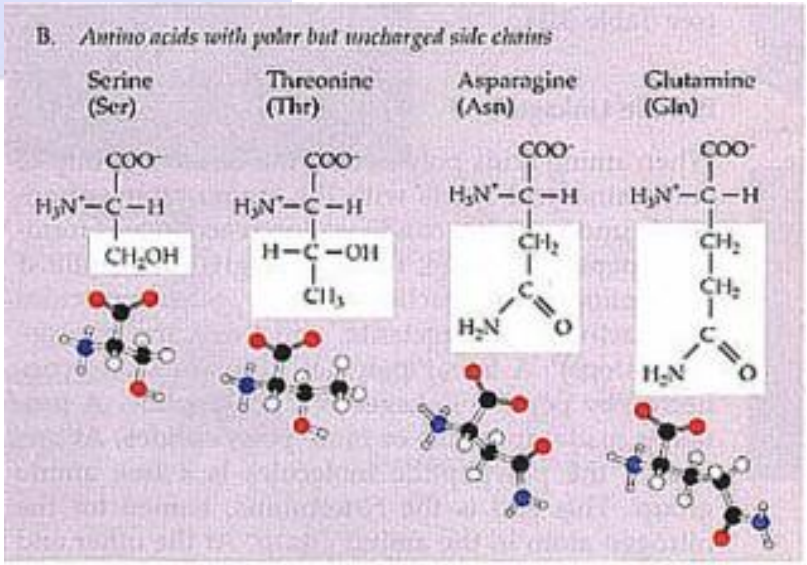
Classification of amino acids



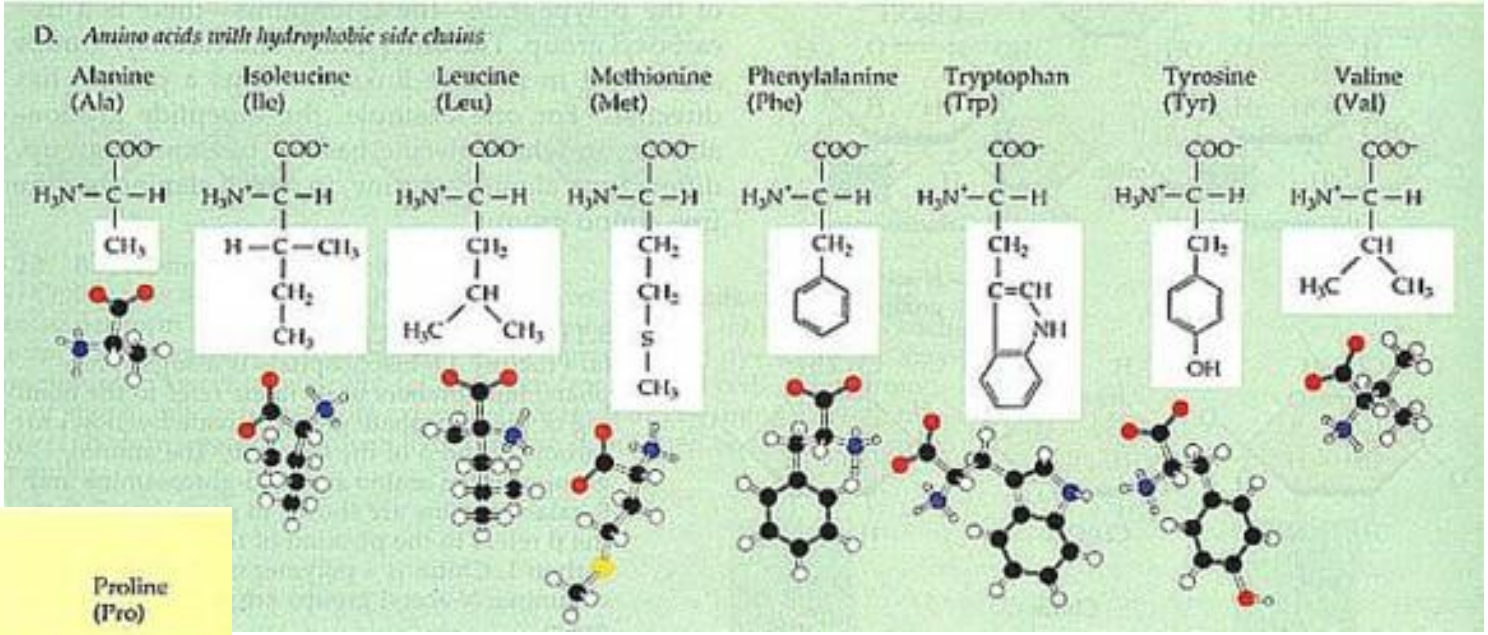
- basic: + NH_2-group
- acidic: + COOH-group
- uncharged polar
- nonpolar: e.g. cysteine $\rightarrow$ disulfide bond

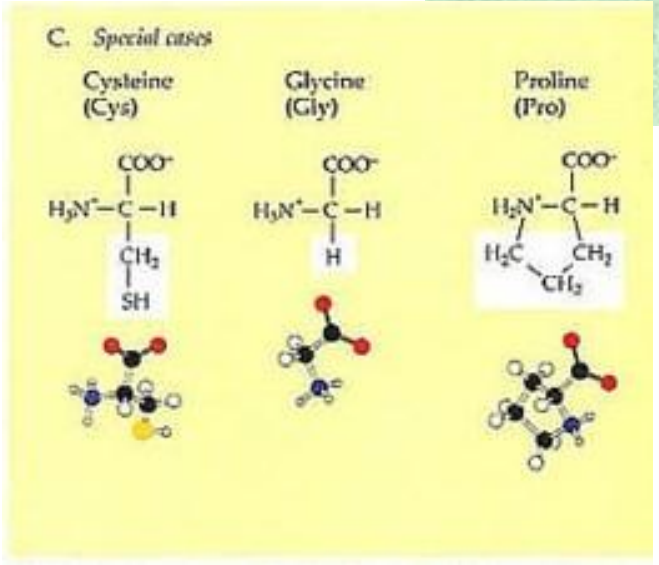
Classification of amino acids II.





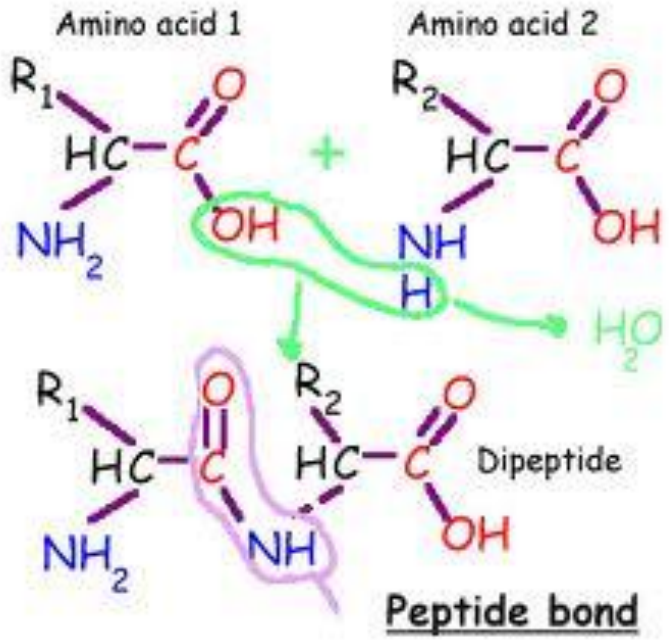
Classification of amino acids III.



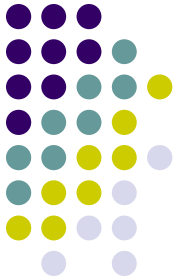


Peptide bond formation

- covalent bond (-CO-NH-)
- N- terminus
- C-terminus

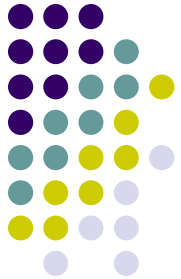


Structural levels of proteins



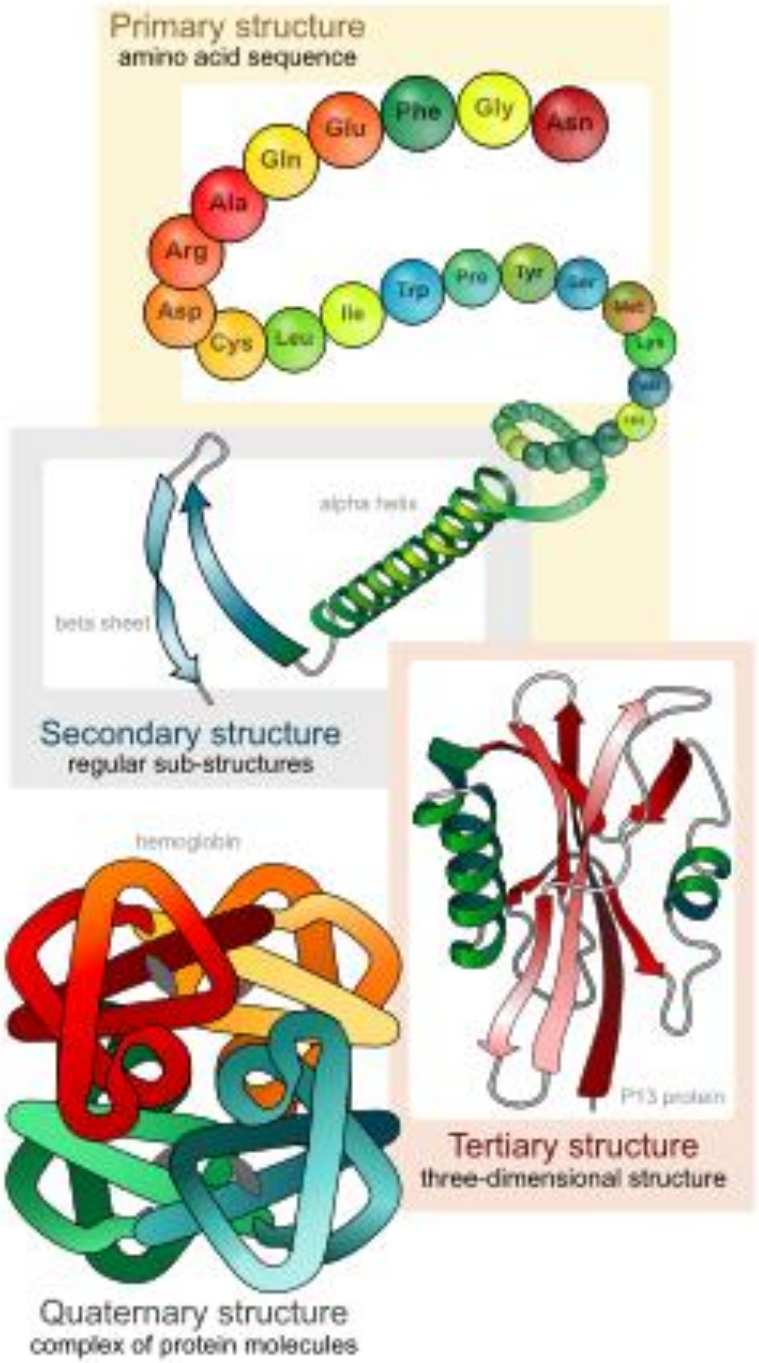
- 1. primary structure
  - sequence of amino acids
- 2. secondary structure
  - α helix
  - β sheet
  - stabilized by H-bonds

Structural levels of proteins II.

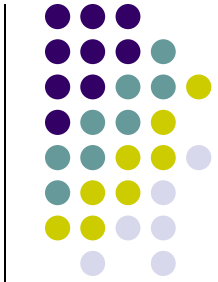


- 3. tertiary structure
  - ionic, nonpolar, disulfide, H-bonds and van der Waals interactions → conformation
  - domains
  - chaperones: folding of the protein

- 4. quaternary structure
  - more than one polypeptide chains
  - subunits

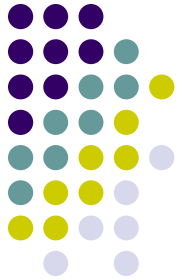

Primary structure
amino acid sequence
Glu
Phe
Gly
Asn
Gln
Ala
Arg
Asp
Cys
Leu
Ile
Trp
Pro
Tyr
alpha helix
beta sheet
Secondary structure
regular sub-structures
hemoglobin
P13 protein
Tertiary structure
three-dimensional structure
Quaternary structure
complex of protein molecules

Types of proteins



- structural proteins → actin
- antibodies (immunoglobulins)
- transport proteins
- channel proteins → ionchannels
- hormones → insulin
- regulatory proteins → transcription factors
- receptors → insulin receptor
- enzymes

Diseases

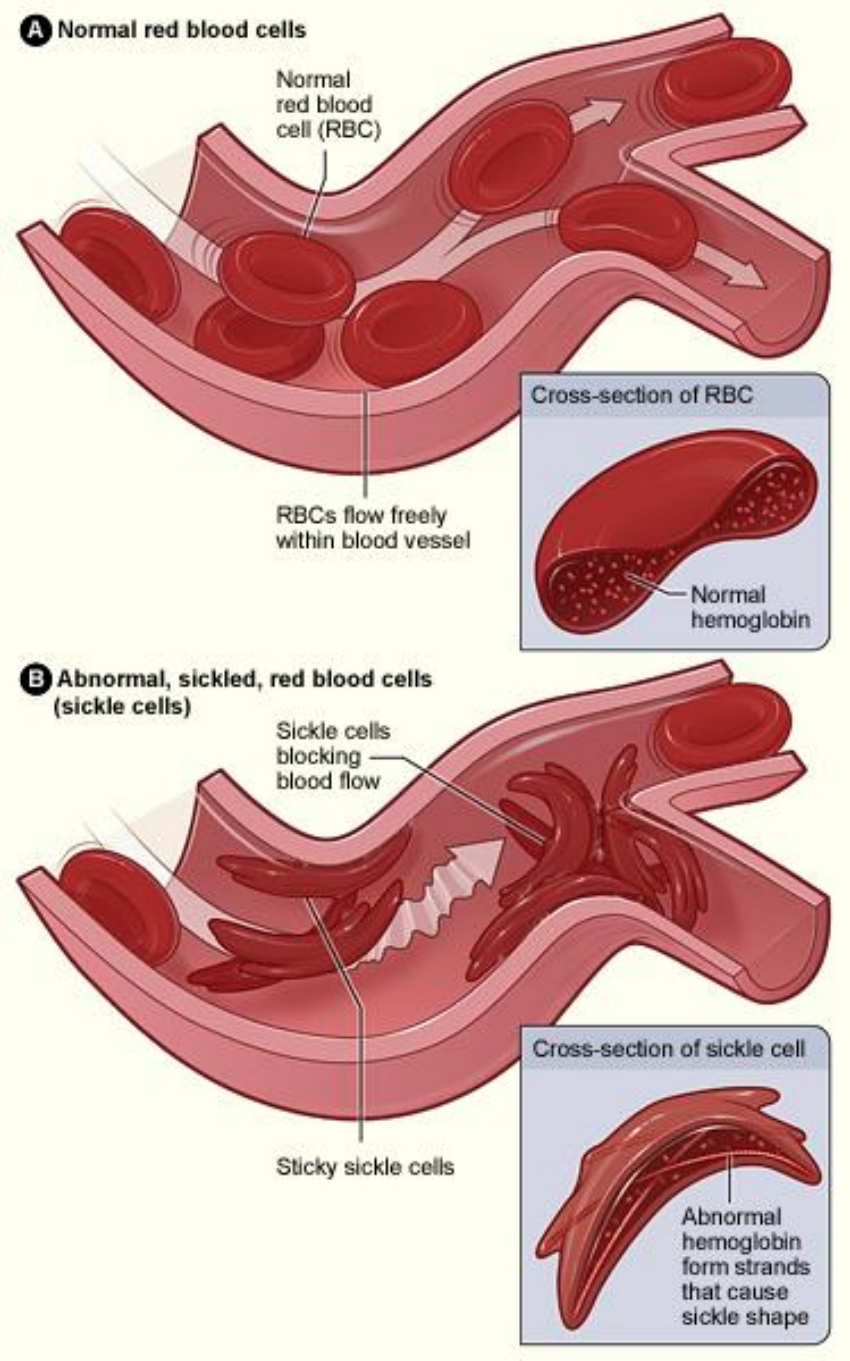


- „little” change in structure – great problem in function

- point mutation in the gene → alteration of the amino acid sequence → change in the conformation → functional abnormality

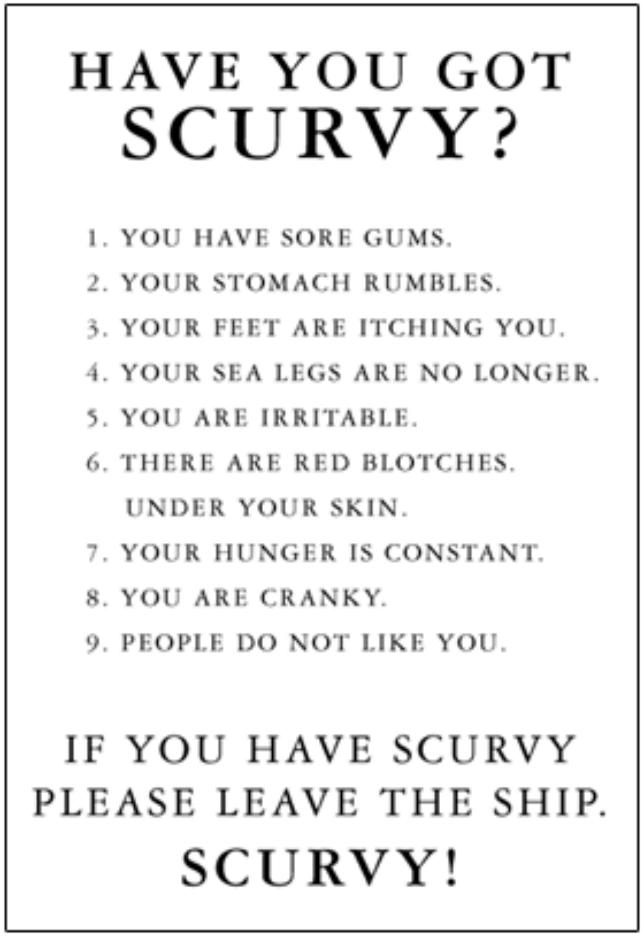
Sickle cell anaemia

- inherited
- point mutation in the β-globin gene
- haemoglobin molecules form precipitates within RBCs
- symptoms:
  - breathlessness, weakness, fever, hematuria
  - susceptibility to infections, excessive thirst


A Normal red blood cells
Normal red blood cell (RBC)
RBCs flow freely within blood vessel
Cross-section of RBC
Normal hemoglobin
B Abnormal, sickled, red blood cells (sickle cells)
Sickle cells blocking blood flow
Sticky sickle cells
Cross-section of sickle cell
Abnormal hemoglobin form strands that cause sickle shape

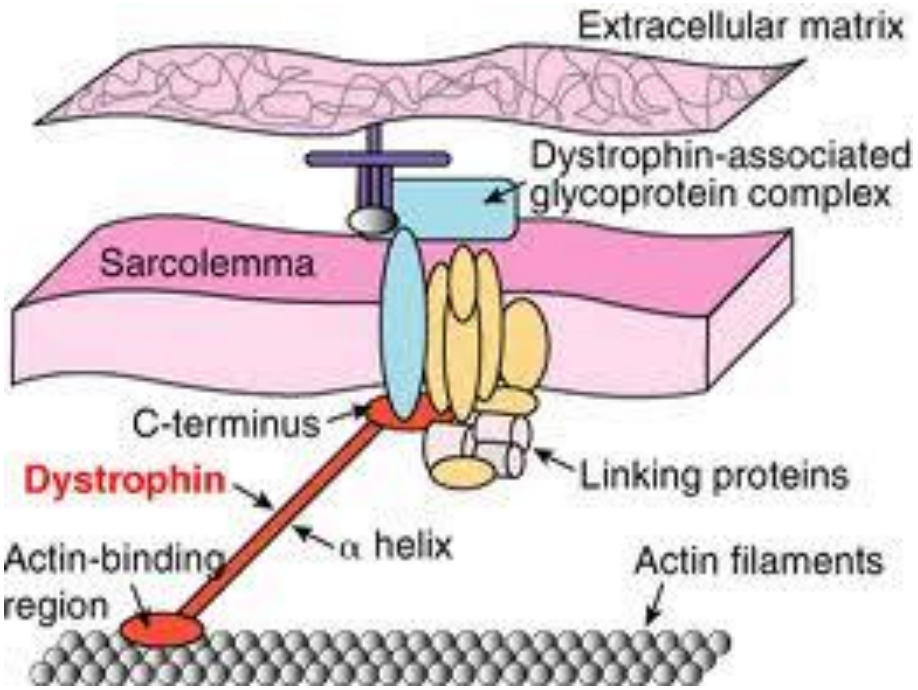
Collagen

- osteogenesis imperfecta
  - fragile bones → deformities
- scurvy
  - lack of vitamin C
  - symptoms:
    - weakness, pale skin, bleeding
    - tender gums, loss of teeth

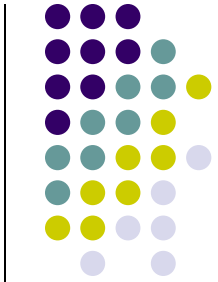


Duchenne muscular dystrophy

- XR inheritance
- mutation in the dystrophin gene → absence of dystrophin
- muscle degeneration



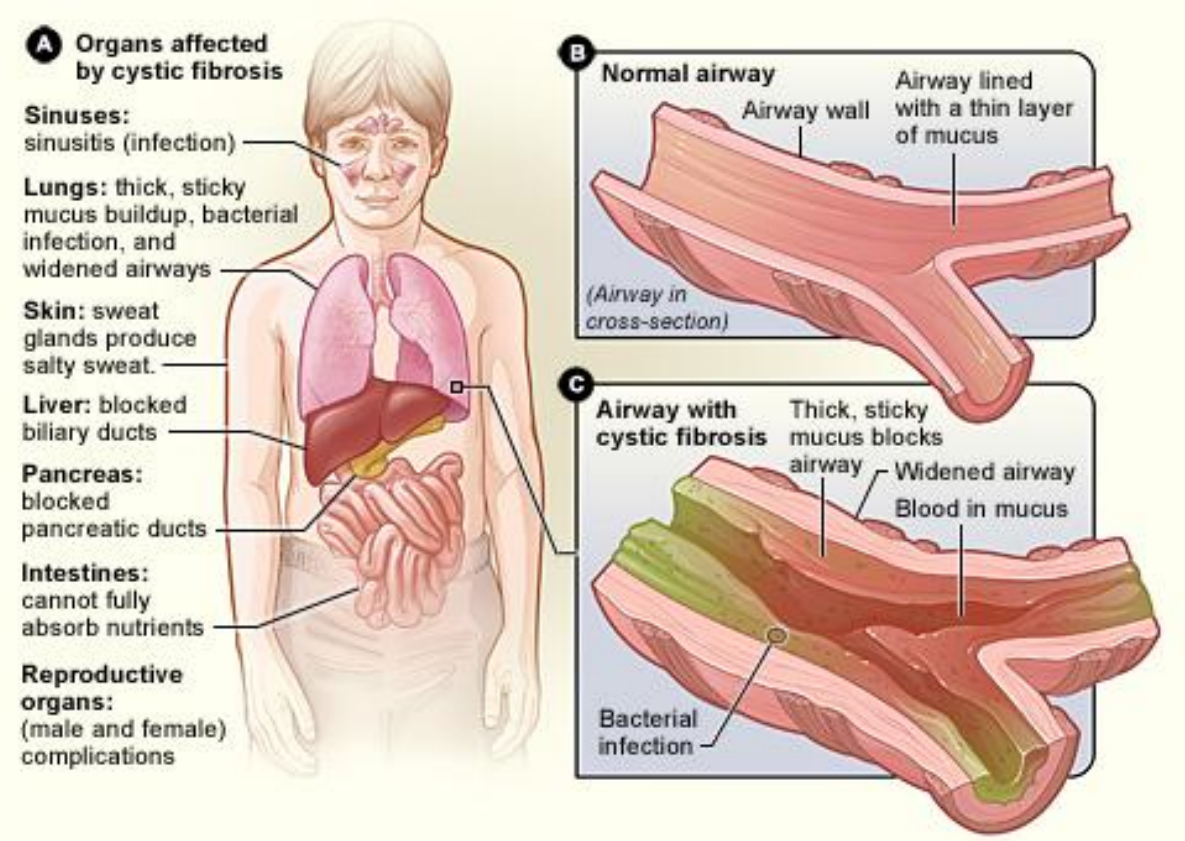
Familial hypercholesterolemia



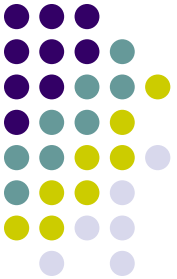
- inherited
- mutation of the LDL receptor gene → cells are not able to uptake enough LDL
- increased risk of atherosclerosis
- acquired form

Cystic fibrosis

- inherited
- mutation in a gene coding for a Cl^- channel



Protein modifications – modified proteins



- glycoproteins:
  - contain carbohydrates
- lipoproteins:
  - lipid-protein complexes
- phosphorylation:
  - attachment of a phosphate group to a protein


A protein called alpha-keratin forms your hair and fingernails, and also is the major component of feathers, wool, claws, scales, horns, and hooves.
The hemoglobin protein carries oxygen in your blood to every part of your body.
Muscle proteins called actin and myosin enable all muscular movement—from blinking to breathing to rollerblading.
Ion channel proteins control brain signaling by allowing small molecules into and out of nerve cells.
Receptor proteins stud the outside of your cells and transmit signals to partner proteins on the inside of the cells.
Enzymes in your saliva, stomach, and small intestine are proteins that help you digest food.
Antibodies are proteins that help defend your body against foreign invaders, such as bacteria and viruses.
Huge clusters of proteins form molecular machines that do your cells' heavy work, such as copying genes during cell division and making new proteins.