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Biochemistry of connective and bone tissue

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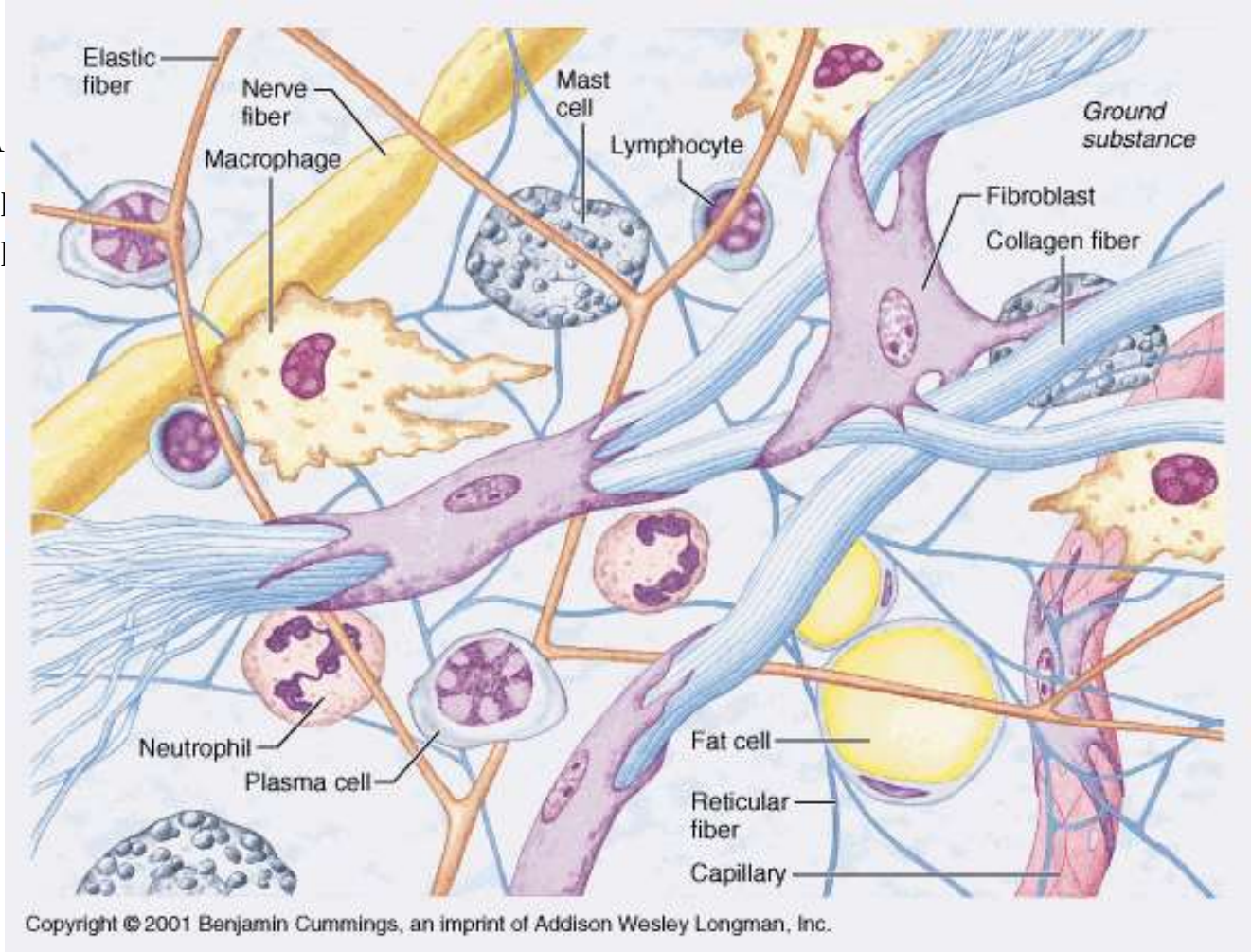
Biomedical significance

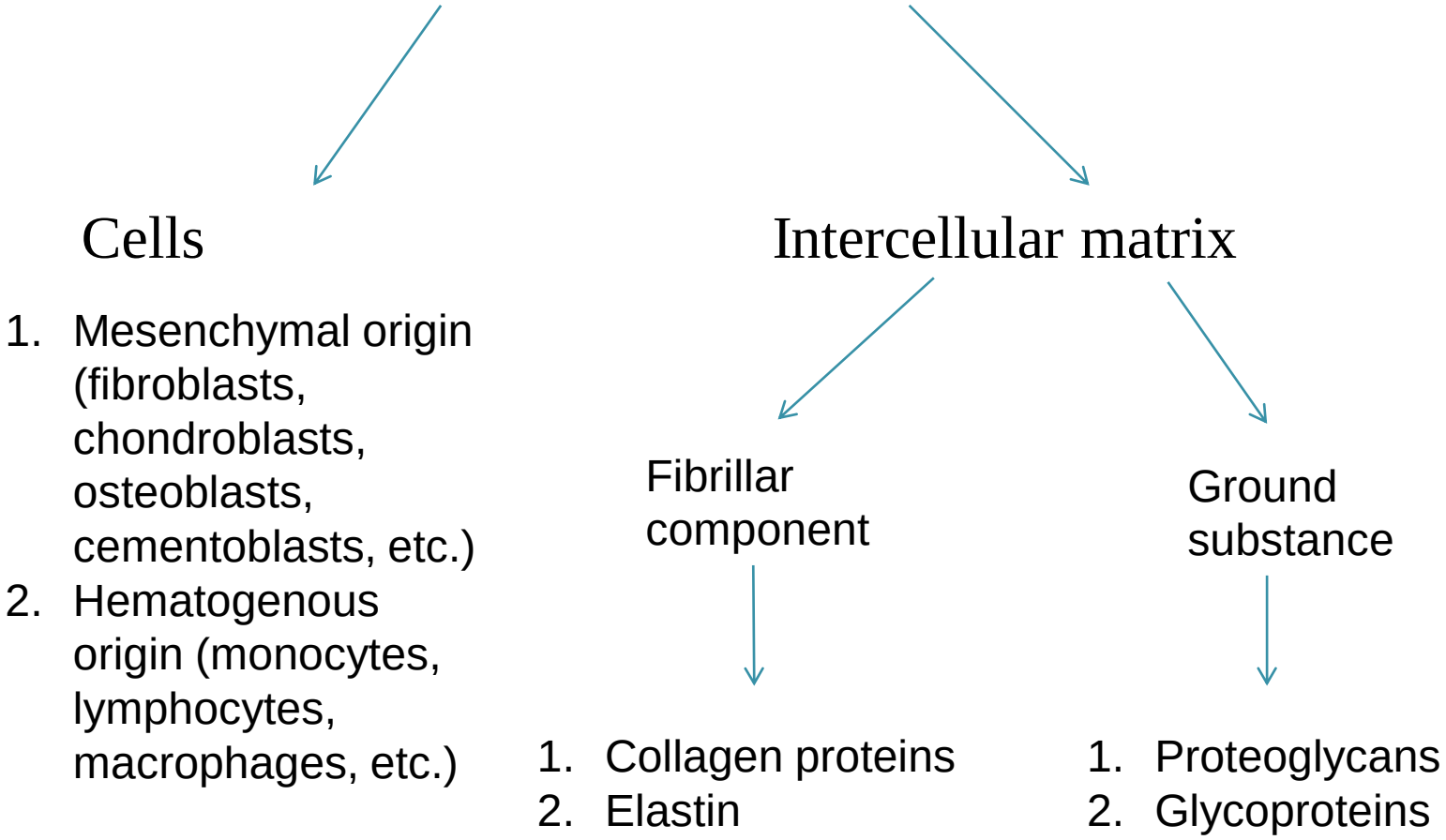
- The basis of the body - 50% of body weight
- Architectonics of organs
- Metabolic function (trophic and excretory)
- Barrier, protective (dermis).
- Depositing (Ca2 +, Mg2 +)
- Development of pathological processes (inflammation, edema, etc.)
- Repair, regeneration.

Types of connective tissue

1. A
2. S
3. S



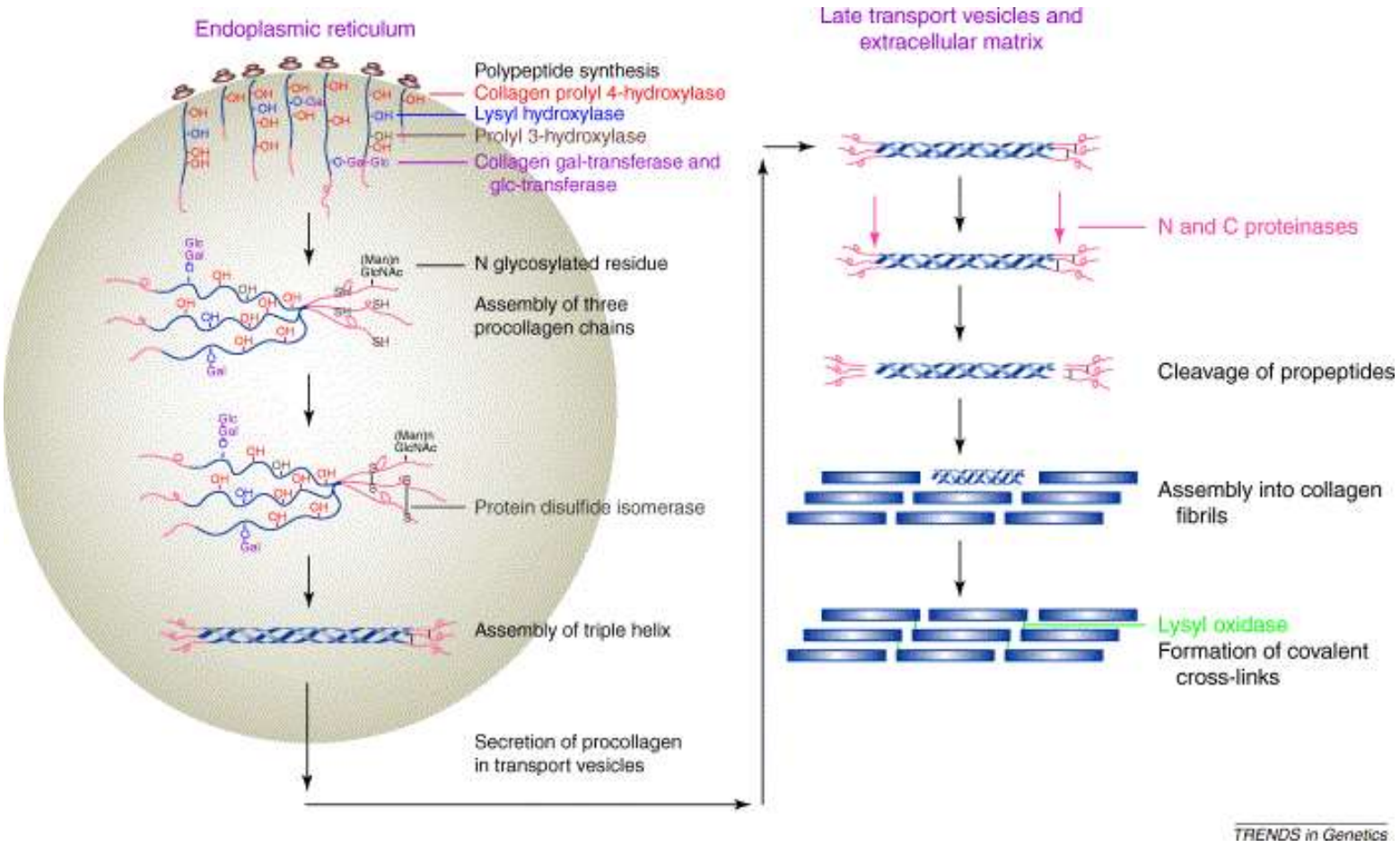
The structure of connective tissue



The structure of collagen

- 50% - skeleton, 40% - dermis, 10% - stroma of internal organs
- 28 types. Fibrillar - I, II, III, V, XI types.
- High molecular weight glycoprotein.
- Structural and functional unit - tropocollagen (300 kDa, 280 nm x 1.4 nm).
- Gly-X-YGly - glycine, X - Pro and 3-, 4-OH-Pro, Y - another AK.

Collagen synthesis



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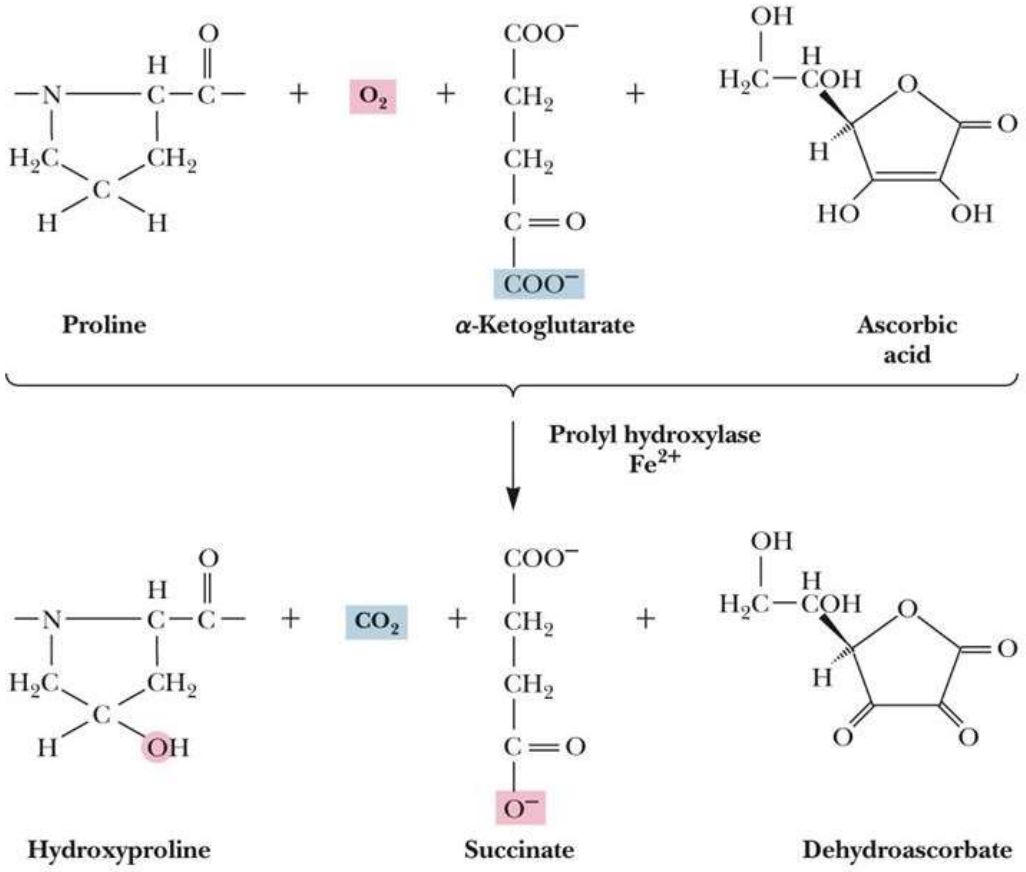
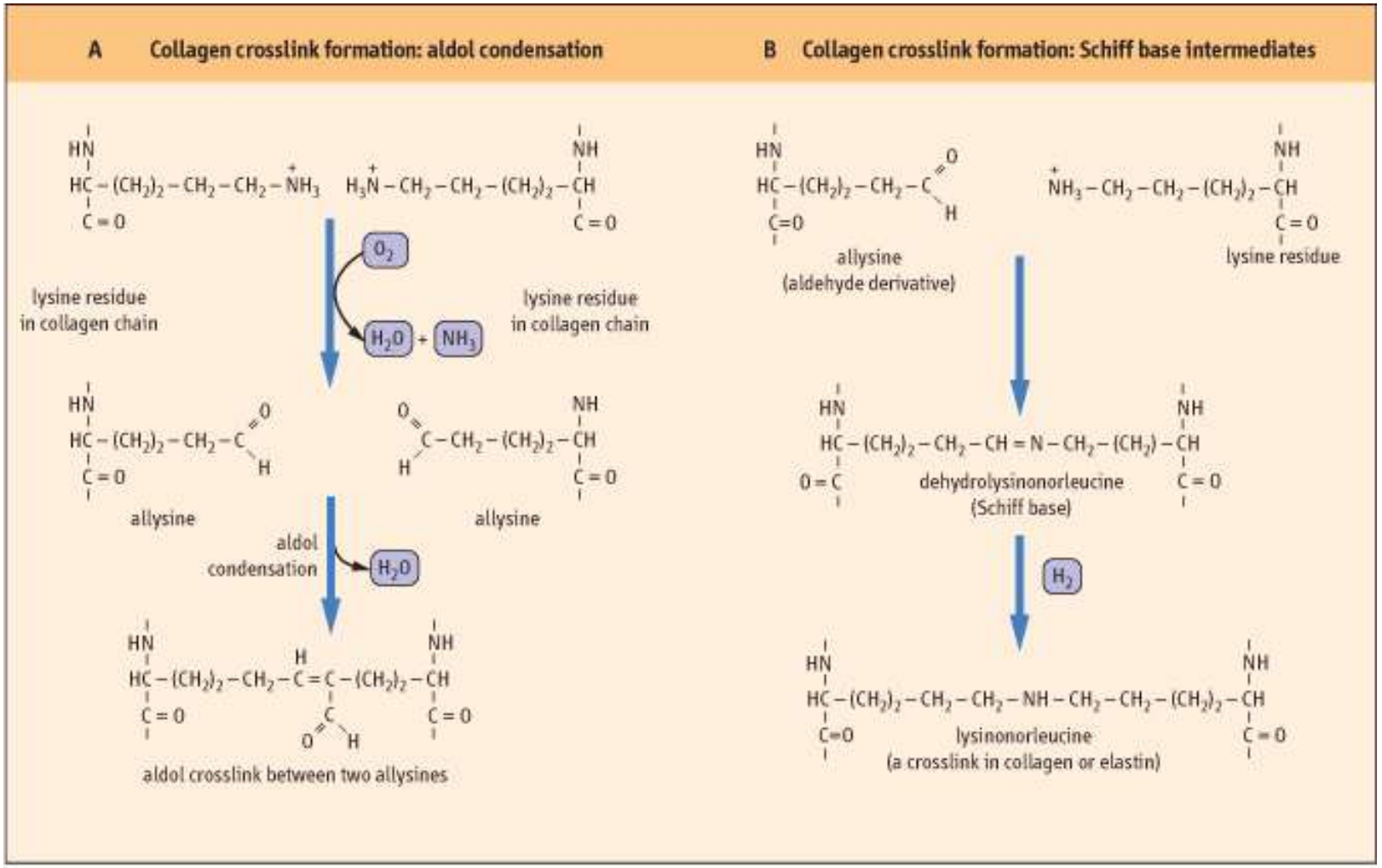
Collagen synthesis



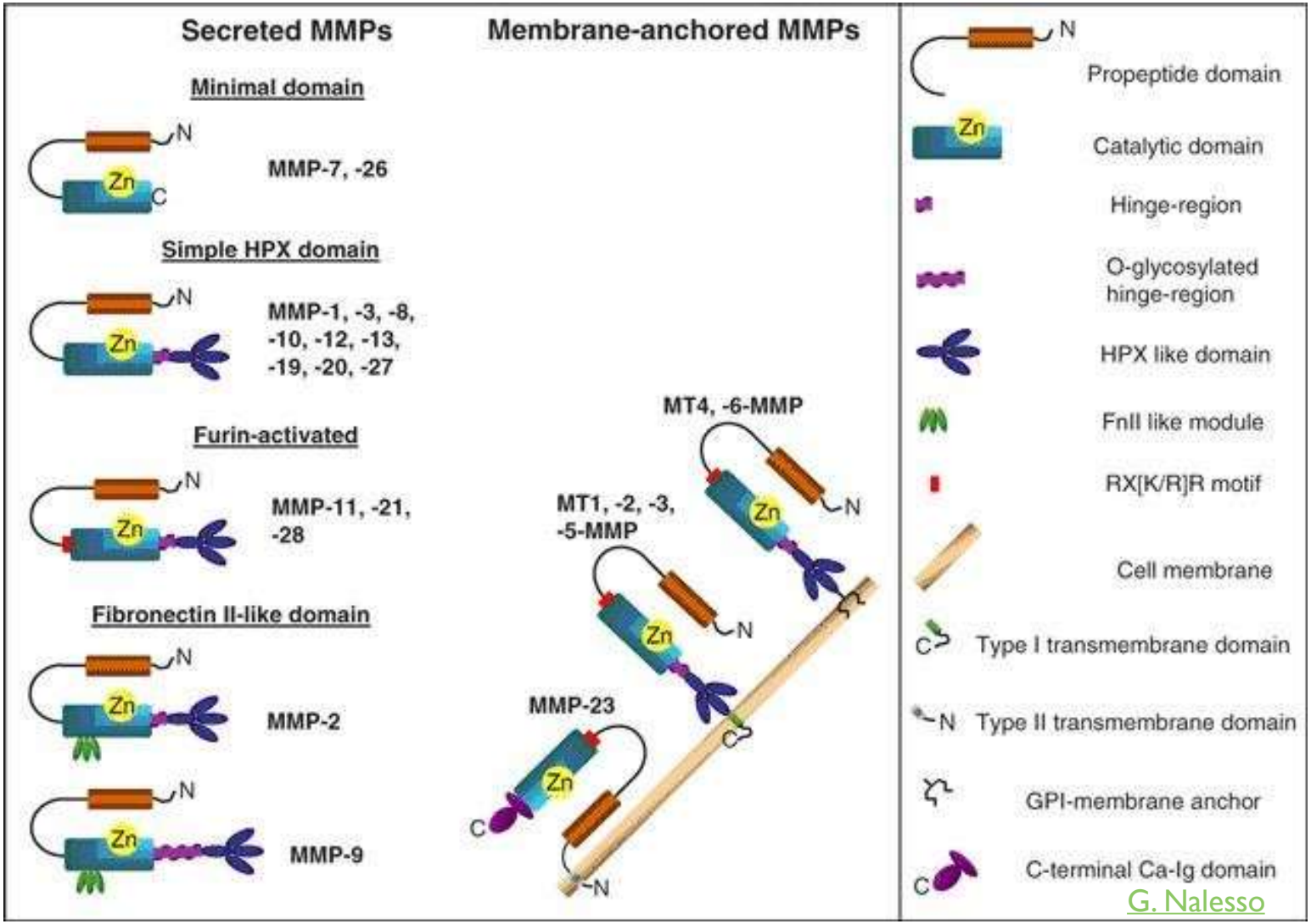
Published by Arianna Fosdick

Scurvy develops on the background of vitamin C deficiency.

Синтез колагену



Collagen breakdown



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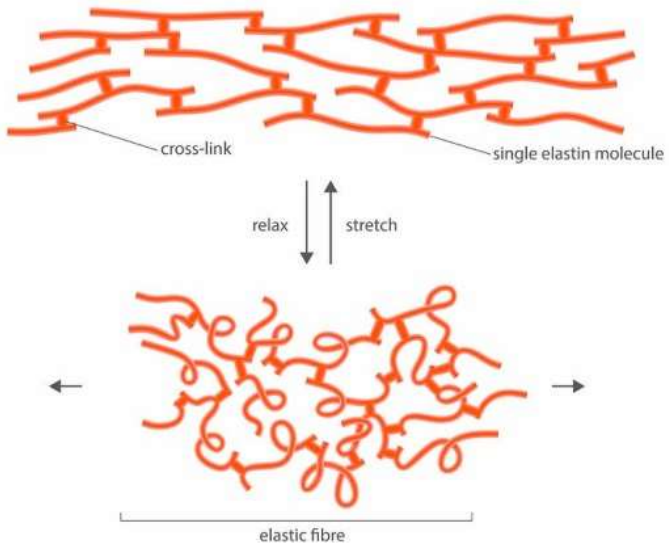
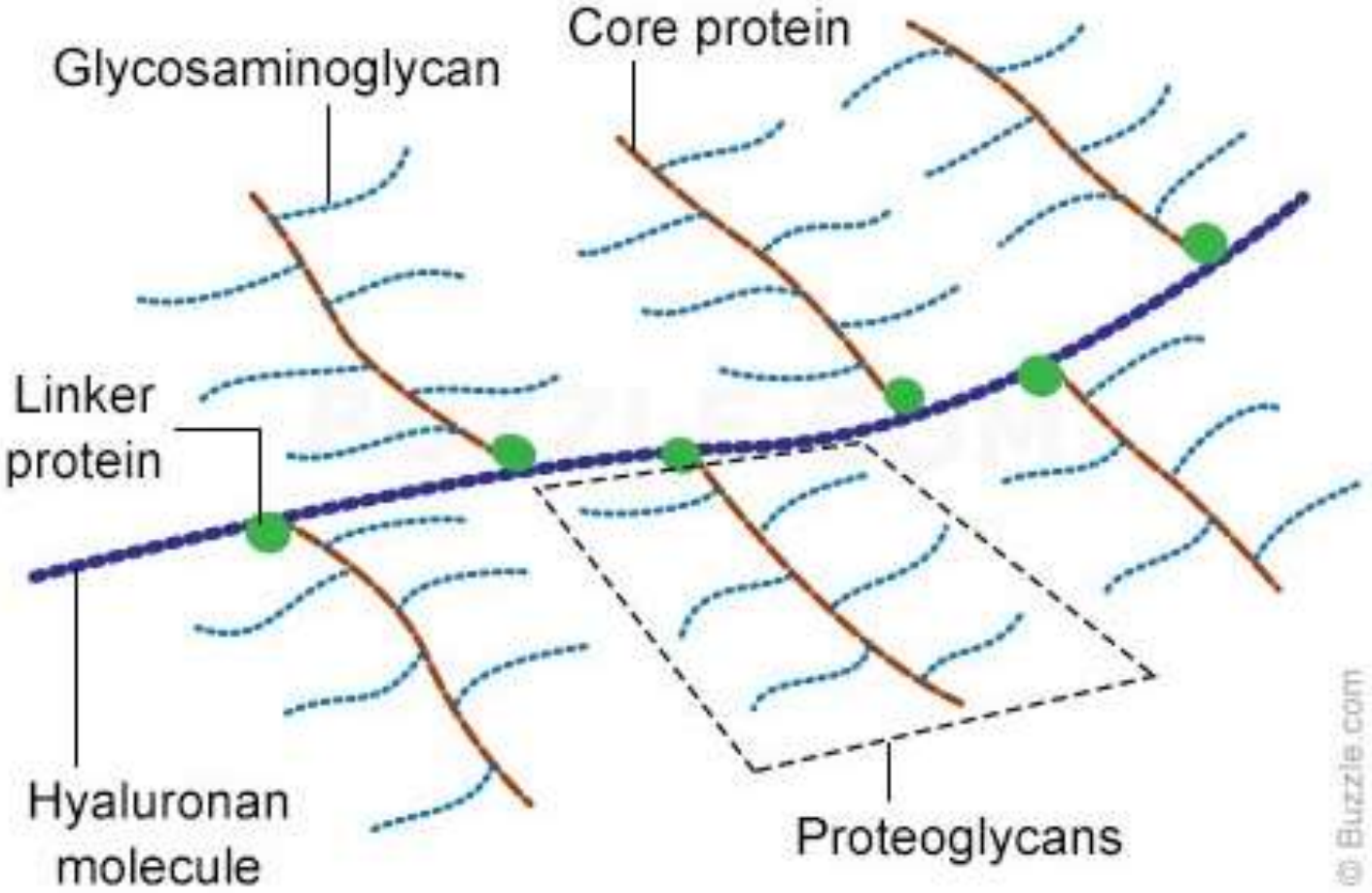
Elastin

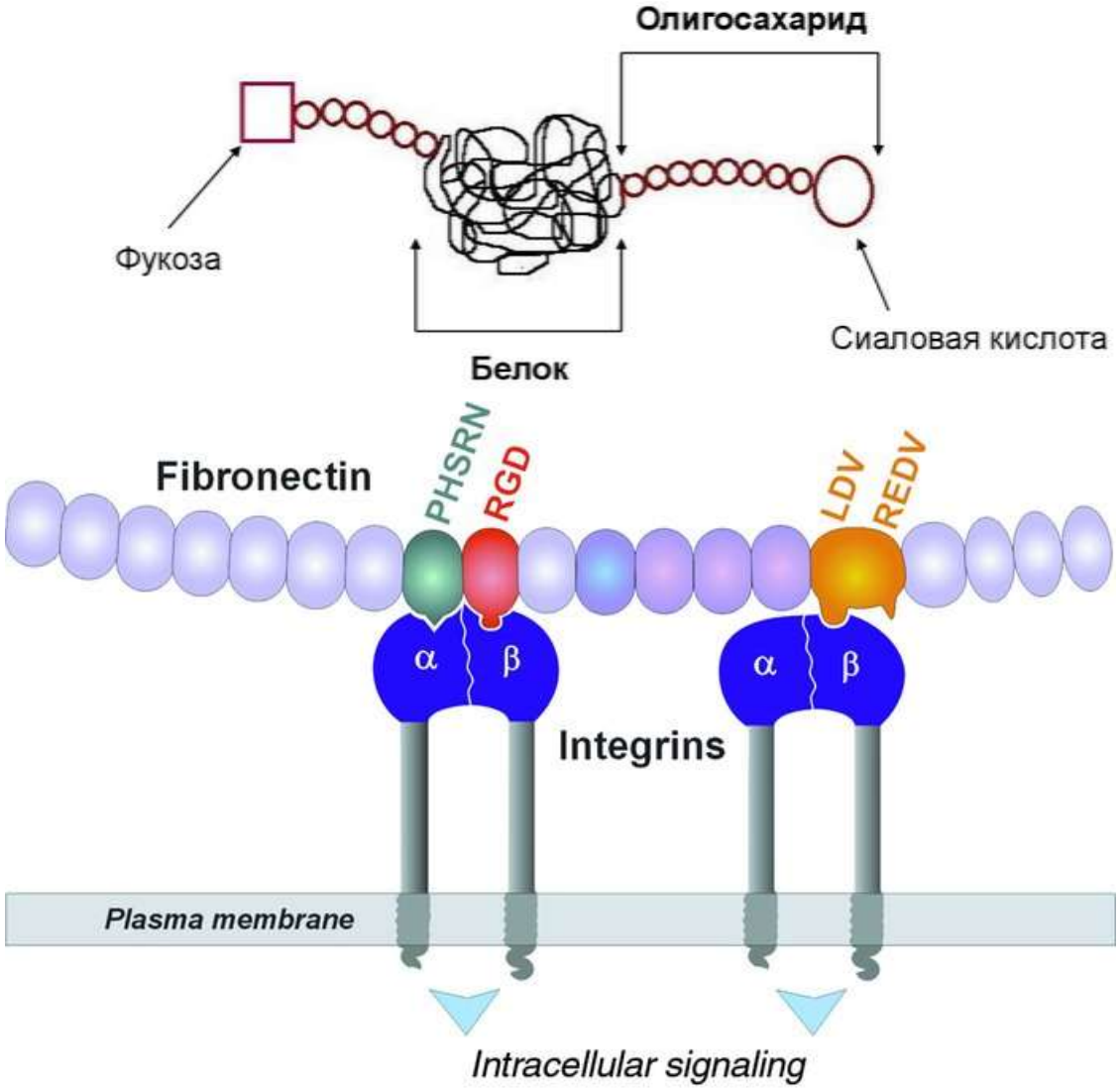


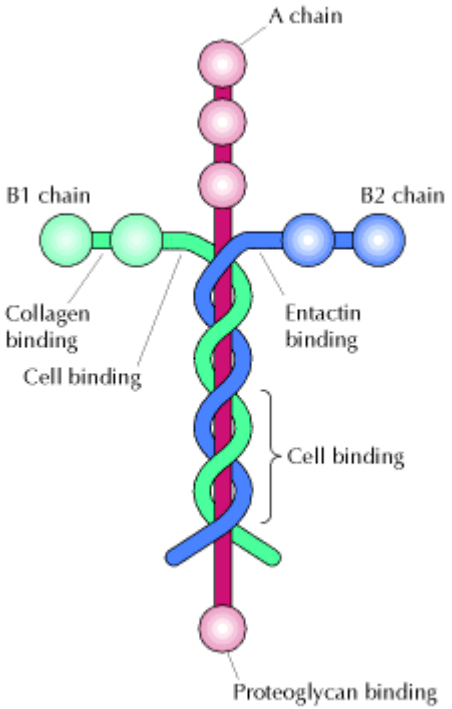
- Glycoprotein, 70 kDa.
- Walls of blood vessels, periodontal tissue, tongue root, submucosal layer of lips and cheeks, lungs, skin.
- 27% glycine, 19% alanine, 10% valine, 4.7% leucine.

Proteoglycans

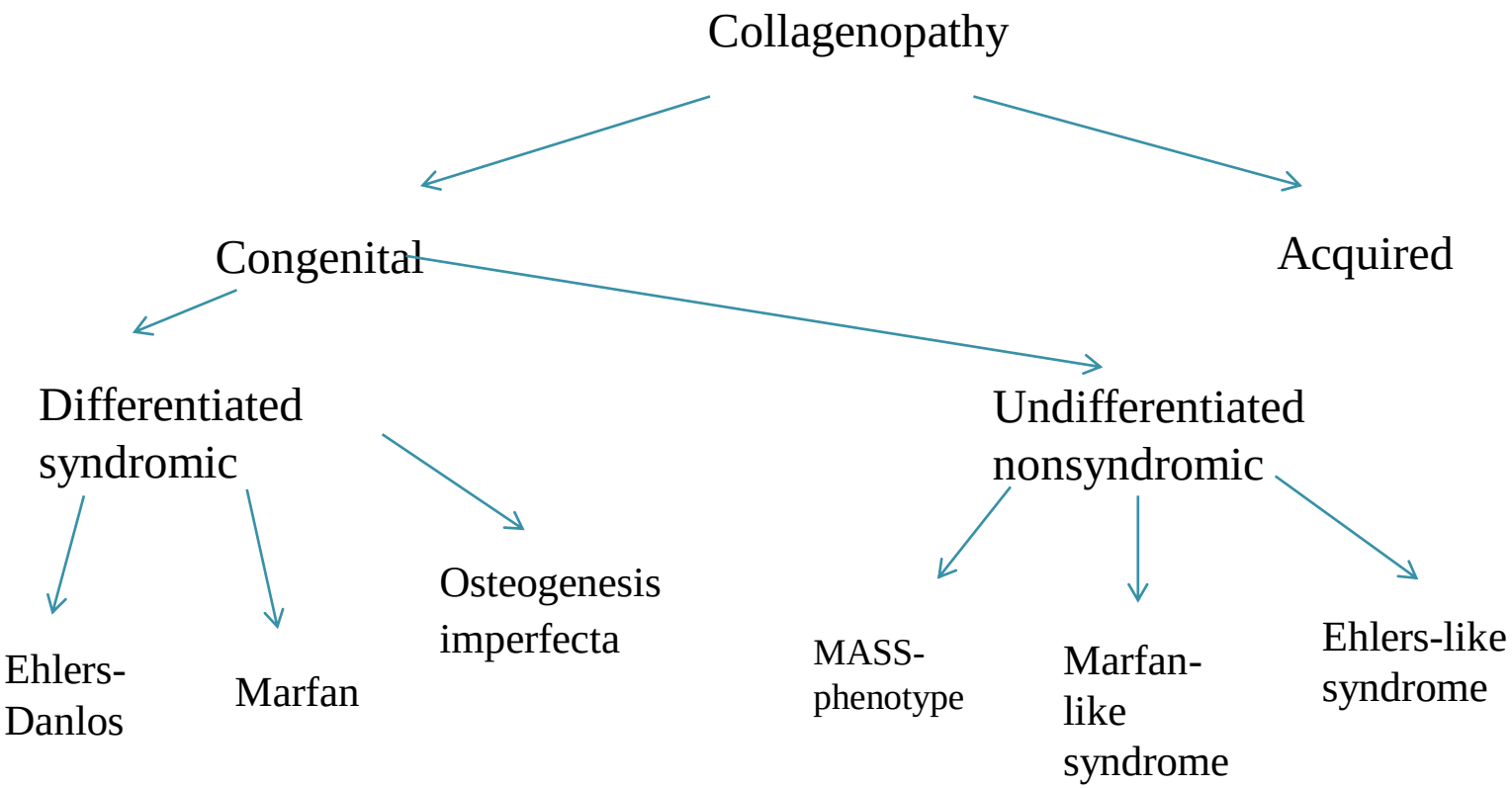


Glycoprtoteins





Collagenopathy

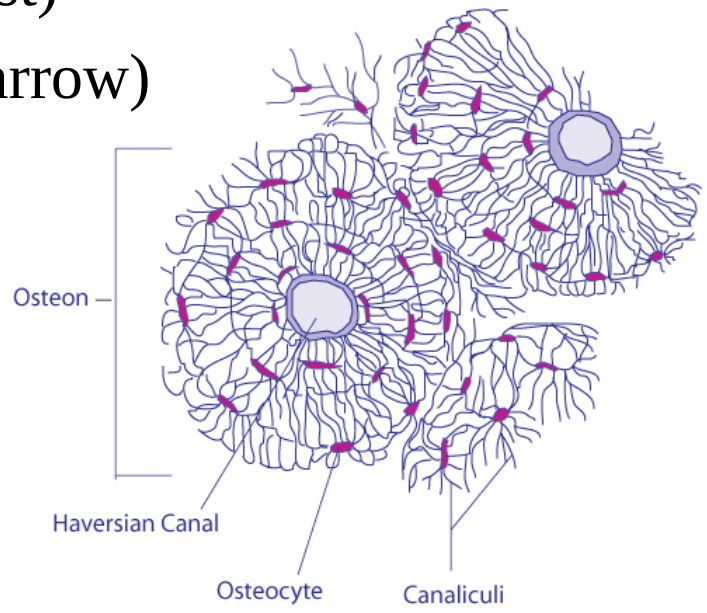


Bone tissue

12-18% of body weight – skeleton

Biological role:

- musculoskeletal
- mineral depot (99% Ca, 87% P, 58% Mg)
- protective (skull, spine, chest)
- hematopoiesis (red bone marrow)



The structure of bone tissue

10% - cells

1. Osteoblast series (mesenchyme) - osteoblasts, osteocytes.
2. Monocyte series - osteoclasts.

90% - intercellular substance

10% water

60-70%
Inorganic components

Crystalline phase

$Ca_{10}(PO_4)(OH)_2$
$Ca_{10}(PO_4)Cl_2$
$Ca_{10}(PO_4)F_2$
$Ca_{10}(PO_4)CO_3$
$Ca_9Sr(PO_4)(OH)_2$

Amorphous phase

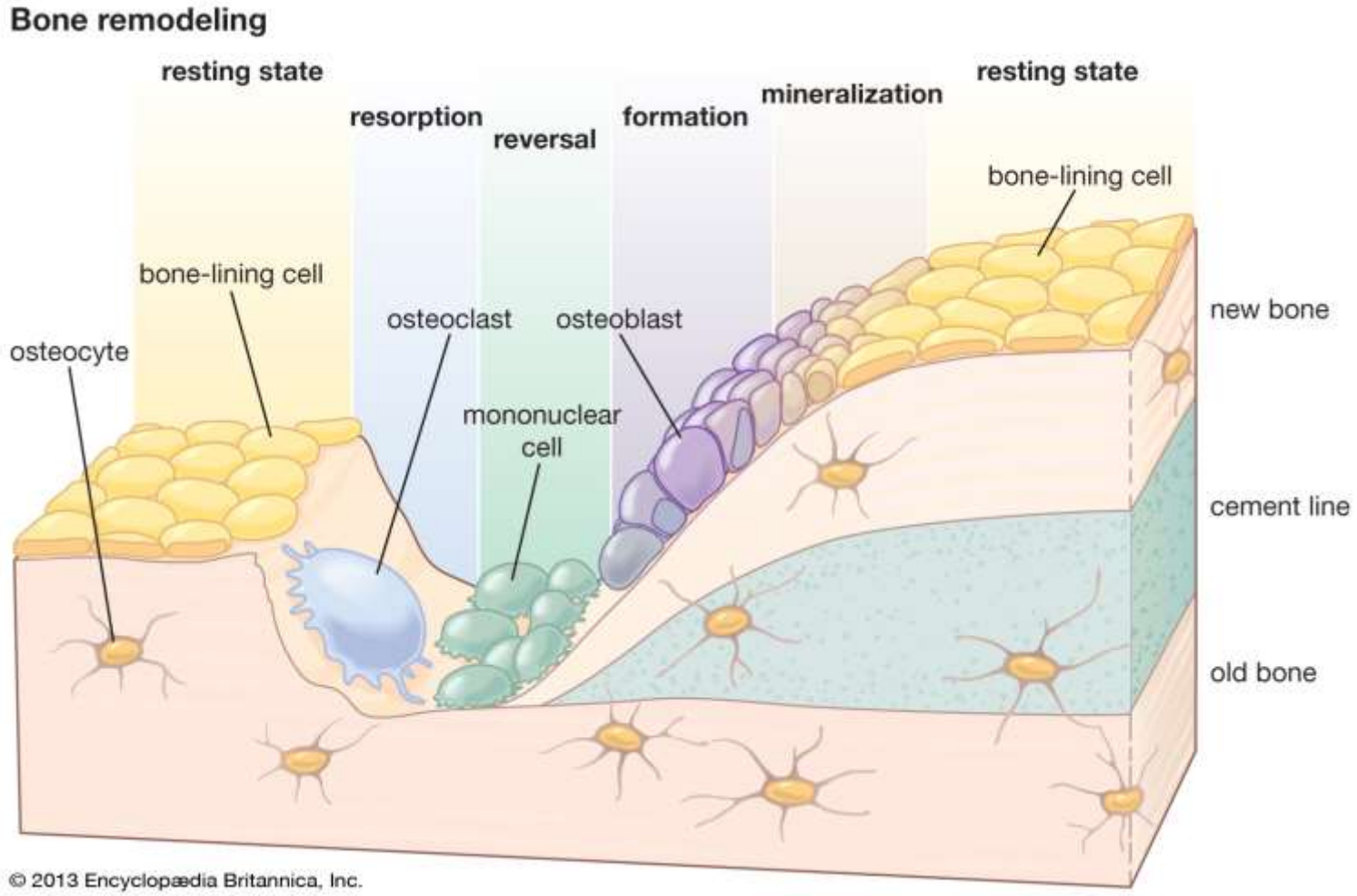
$Ca_3(PO_4)_2$

20%
Organic components

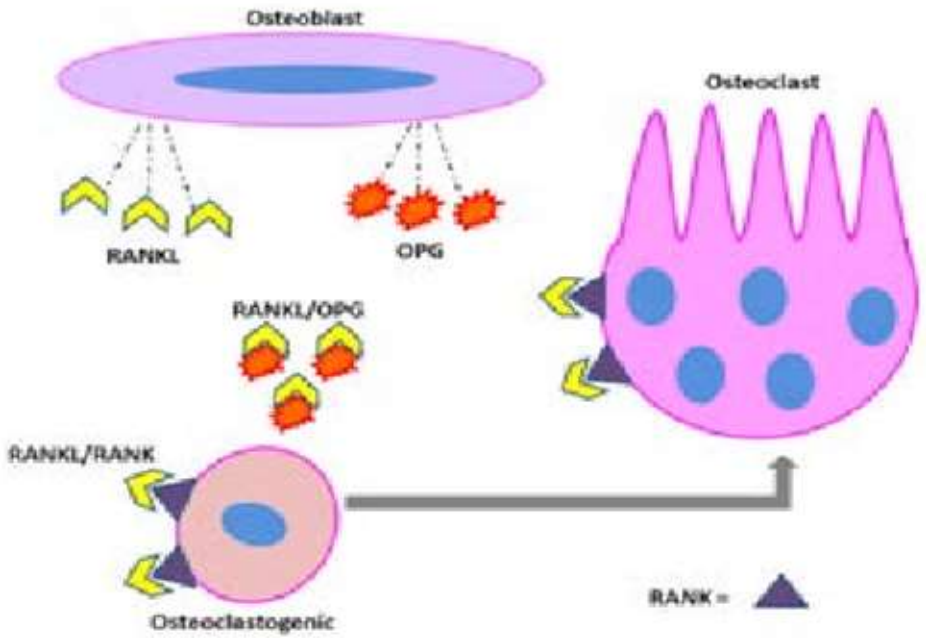
1. Collagen proteins (type I)
2. Non-collagen proteins

- Osteocalcin
- Osteonectin
- Osteopontin
- Thrombospondin
- Glycoproteins
- Proteoglycans

Bone remodeling

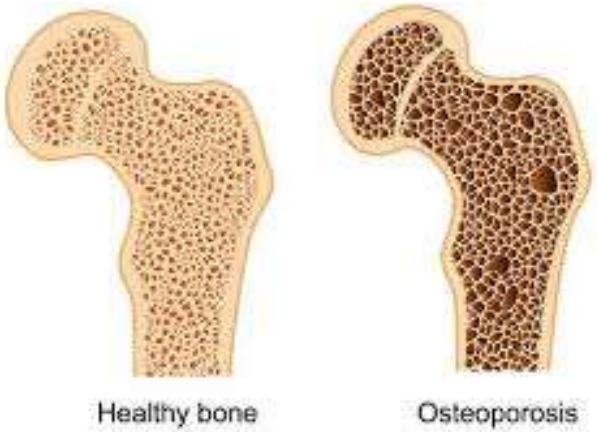


Bone remodeling



Osteoporosis

1. Primary - involutionary
   - postmenopausal
   - senile
2. Secondary:
   - on the background of



   - on the background of an imbalance in nutrition.
   - on the background of prolonged immobilizationon
   - on the background of neurogenic anorexiad.
   - on the background of synthetic glucocorticoids
   - as a result of a gastrectomy, malabsorption, diseases of a digestive tract.

Diagnosis of bone lesions

1. Resorption markers:

- Increased acid phosphatase activity
- Increase in total collagenase activity
- Increase in hydroxyproline content
- Increasing the content of sialic acids

2. Markers of formation:

- Decreased osteocalcin content
- Increase in alkaline phosphatase activity (bone isoform)
- Determination of osteoprotegerin content.

Treatment of osteoporosis

- RUNKL inhibitors (Denosumab)
- Antiresorbents - calcitonin ("Miacalcic"), bisphosphonates ("Alendronate")
- Selective stimuli of estrogen + androgen receptors.
- Phytoestrogens.
- Calcium + vitamin D.

Sourcesof information

• Biological and Bioorganic Chemistry: in 2 books. Book 2. Biological Chemistry /Yu.Gubsky, I.V. Nizhenkovska, M.M. Kordaet al. ; edited by Yu.Gubsky, I.V.Nizhenkovska. –Kyiv:AUSMedicine Publishing, 2020.-544 p.ISBN978-617-505-785-8

• HalkerstonI.D.K. Biochemistry: 2nd edition. The National medical series for independent study/HalkerstonI.D.K. -1988. -522 p.

• Harper`s Biochemistry. R.K.Murray, D.K.Granner, P.A.Mayes, V.W.Rodwell. Prentice-Hall International Inc., 2010. –1134 p.

• GubskyYu. Biological chemistry: textbook. –Vinnytsia: Nova Knyha, 2017. –488 p.

• KoolmanJ. Color Atlas of Biochemistry/ J.Koolman, K.-H. Rom. – Stuttgart. New York. –ThiemeVerlag. —1996. –435 p.

• LehningerA. Principles of Biochemistry/ LehningerA. –New York. – W.H.Freemanand Company. –2005. –1010 p.

• Pamela C.ChampeLippincott’s Illustrated Reviews: Biochemistry, 3rd Edition / Pamela C.Champeand Richard A.Harvey. –Baltimore, Lippincott Williams & Wilkins, MD ©, 2005. –534p.