



# Connective Tissue

# General Features

Originates mostly from mesoderm.

Composed of cells, fibres and extracellular matrix.

Highly vascular.

Variable regenerative power.

# Functions of Connective Tissue

Support:

Defense and protection.

Storage.

Medium for exchange.

# Extracellular Matrix

Extracellular Matrix = ground substance + fibres.

- Resists compression and stretching forces.
- The water content allows rapid exchange of metabolites.

# Ground Substance

## Composed of:

- Glycosaminoglycans:
  - Sulfated: keratan sulfate, chondroitin sulfate, dermatan sulfate and heparin.
  - Non-sulfated: hylauronic acid
- Proteoglycans: Responsible for the gel state of the extracellular matrix.
- Adhesive glycoproteins: laminin, chondronectin, osteonectin and fibronectin.

## Types of GAGs

GAG	Distribution
<b>Hyaluronic acid</b>	Most connective tissue, cartilage, dermis, synovial fluid.
<b>Keratan sulfate</b>	Cartilage, cornea, intervertebral disc.
<b>Heparan sulfate</b>	Blood vessels, lung, basal lamina
<b>Chondroitin 4-sulfate</b>	Cartilage, bone, blood vessels
<b>Chondroitin 6-sulfate</b>	Cartilage, blood vessels, umbilical cord.
<b>Dermatan sulfate</b>	Skin, heart valves, blood vessels
<b>Heparin</b>	Mast cell granules, basophils, liver lung, skin.

# Functions of Proteoglycans

Resistance of compression.

Retardation of movement of microorganisms.

Act as a filter.

Possess binding sites for growth factors.

# Connective Tissue Fibres

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graph TD; A[Connective Tissue Fibres] --> B[Collagen]; A --> C[Elastic]; B --> D[Reticular]
```

Collagen

Elastic

Reticular



# Collagen Fibres

Gives the extracellular matrix strength to resist tensile forces.

Formed of protein collagen (20% of all proteins of the body).

H & E: long, wavy pink bundles.

E.M: cross banding at 67 nm.

Fibres are formed of aggregation of fibrils.

Fibrils are formed of tropocollagen.

Tropocollagen is formed of 3 helical polypeptide chains.

**Collagen bundle**



```
graph TD; A[Collagen bundle] --> B[Fibres]; B --> C[Fibrils]; C --> D[Tropocollagen]; D --> E[3 Helical polypeptide chains, α-chains.]
```

**Fibres**

**Fibrils**

**Tropocollagen**

**3 Helical polypeptide chains,  $\alpha$ -chains.**

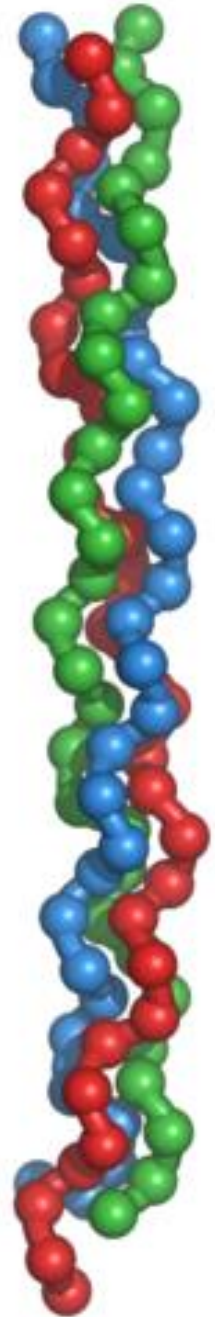
$\alpha$ -chains possess 1000 amino acids.

Every 3<sup>rd</sup> amino acid is glycine.

- Other amino acids: proline, hydroxyproline, hydroxylysine.

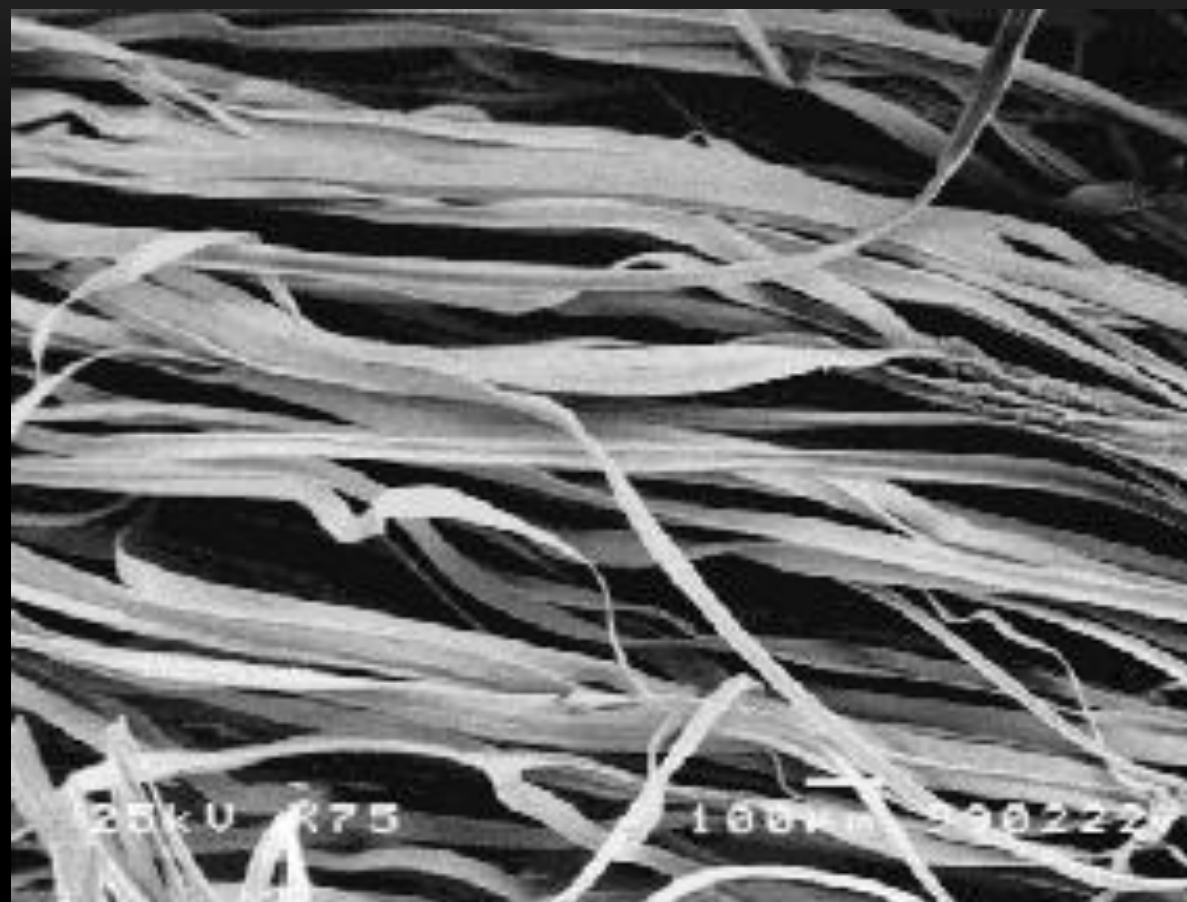
The sequence of amino acids determines the type of collagen.

- There are 16 types of collagen.



**Julian Voss-  
Andreae's**  
sculpture  
*Unraveling  
Collagen* (2005),  
stainless steel,  
height (3.40 m).

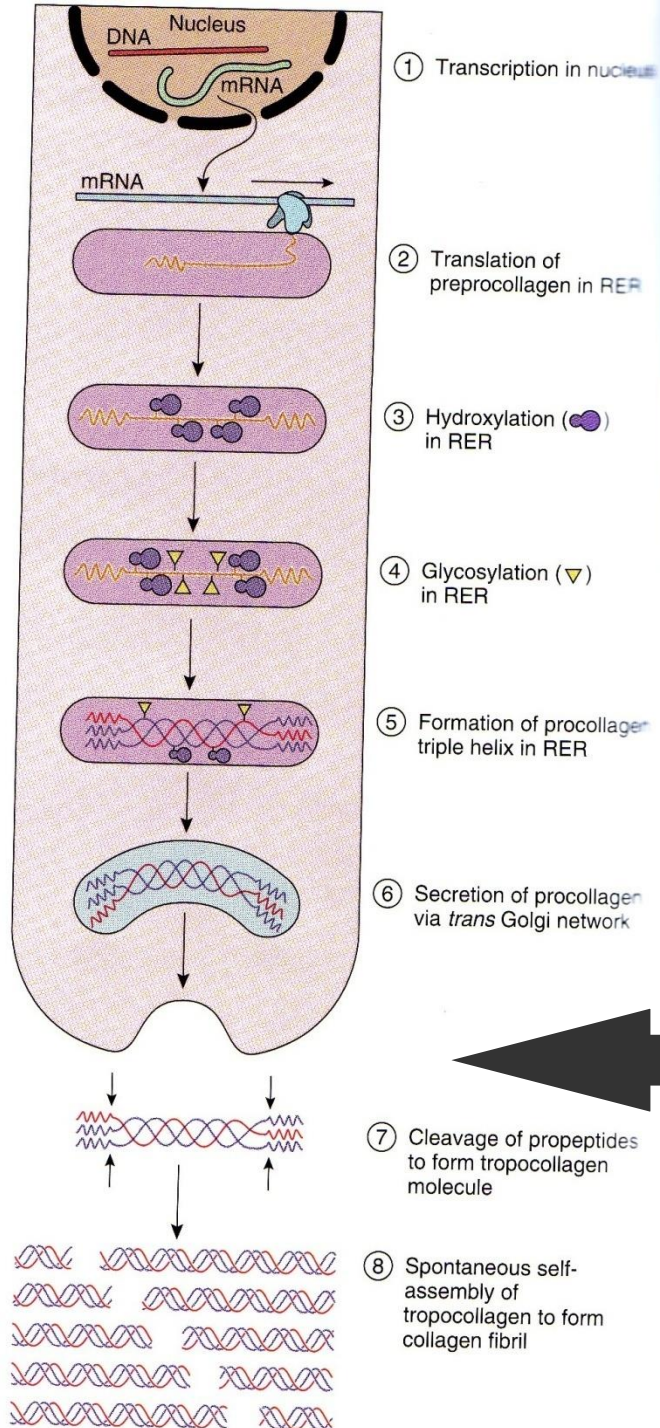






## Major Types of Collagen

Type	Synthesizing cell	Function	Location
I	Fibroblast, osteoblast, odontoblast, cementoblast	Resist tension	Dermis, tendons, ligament, capsules, bone, dentin, cementum
II	chondroblasts	Resists pressure	Hyaline and elastic cartilage
III	Fibroblasts, reticular cells, smooth muscle, hepatocytes	Form structural framework of organs	Reticuloendothelial system, lung, skin
IV	Epithelium, muscle, Schwann cells	Meshwork of the lamina densa	Basal lamina
V	Fibroblasts, mesenchymal cells	Associated with type I.	As in type I and placenta
VII	Epidermal cells	Anchoring fibrils between the lamina densa and reticularis	Derma-epidermal junction



## Intracellular

\* Transcription (Nucleus).

\* Translation (rER).

\* Hydroxylation (rER).

\* Glycosylation (rER & Golgi).

\* Formation of the triple helix.

\* Secretion of procollagen (trans Golgi network and microtubules).

**\*\*\* Vit. C is essential**

## EXTRA CELLULAR

Cleavage and assembly

# Elastic Fibres

Composed of elastin and microfibrils.

Elasticity is due to elastin.

- Elastin = glycine + proline + lysine.

Stability is due to microfibrils.



# Reticular Fibres

Short, thin and branching.

Give PAS +ve reaction.

Stain with Silver Nitrate  
(*Argyrophylic*).

Found mainly in hematopoietic organs.

# Cellular Components of Connective Tissue

## Fixed cells:

- Fibroblasts.
- Adipose cells.
- Pericytes.
- Mast cells.
- Macrophages.

## Transient cells:

- Plasma cells.
- White blood cells.
- Macrophages.

# Fibroblasts

The most numerous cells of connective tissue.

Occur in active and inactive forms (fibrocyte).

Originate from undifferentiated mesenchymal cells.

Capable of some movement.

Rarely undergo division.

May differentiate into other types of cells.

# Active fibroblasts

Closely associated with collagen bundles.

Elongated, fusiform, and have many processes.

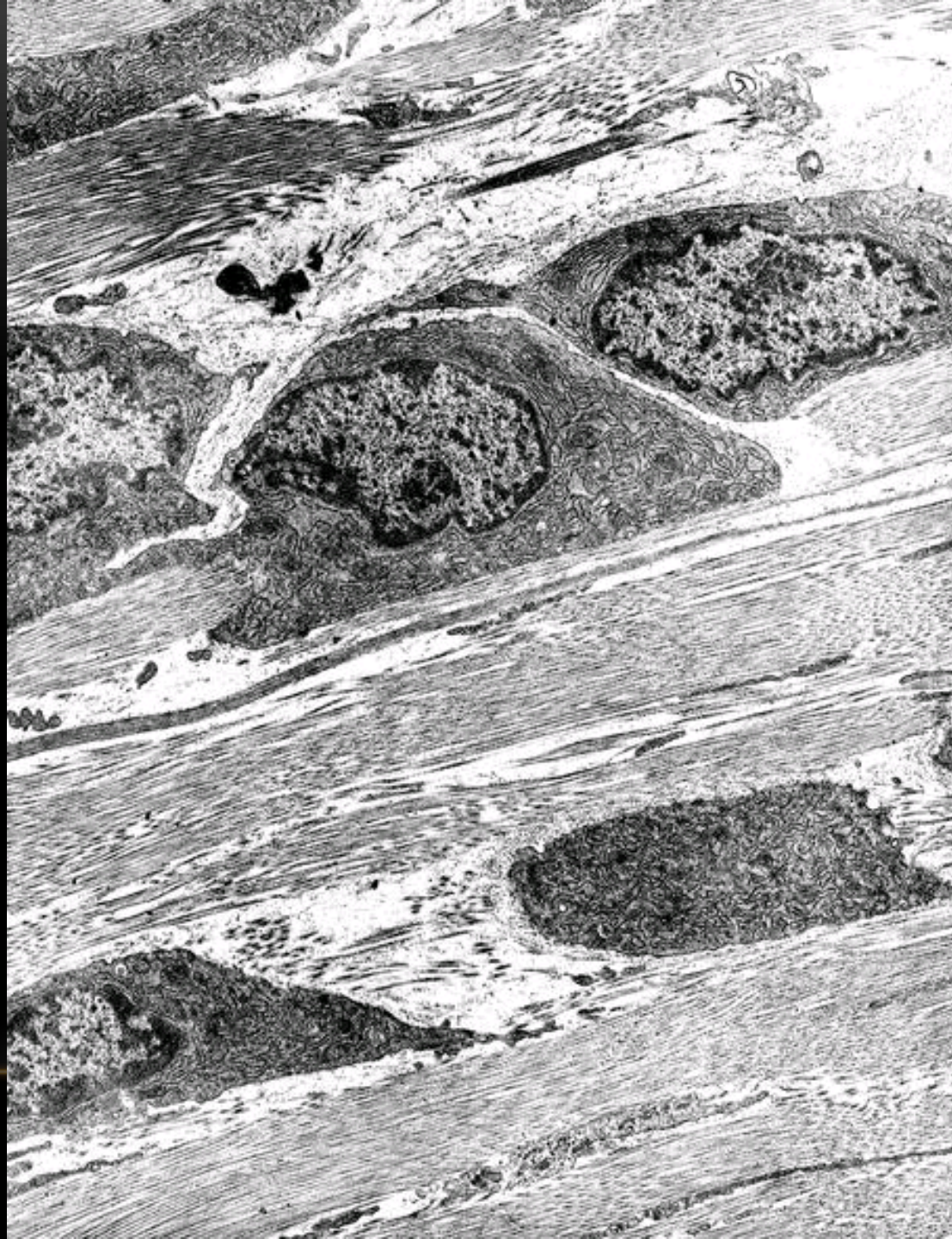
Cytoplasm is pale and difficult to be differentiated from near by tissue.

Nucleus is large, dark stained and granular.

E.M: prominent Golgi, mitochondria, rER, actin and myosin.







# Inactive Fibroblast (Fibrocyte)

Smaller and ovoid with acidophylic cytoplasm.

The nucleus is smaller and darker.

Few processes.

E.M: few rER and many ribosomes.







Oedema

