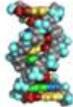
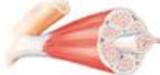


# Tissues

Edited by Gergely Berta

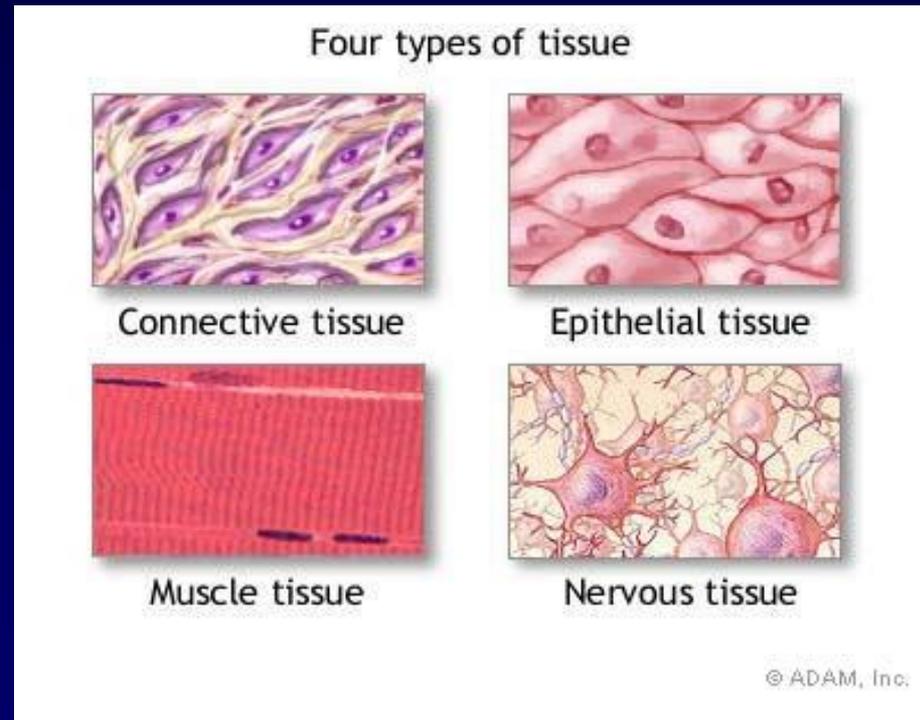
# Levels of organization

Level of Organization	Explanation	Example
 Atomic Level	Atoms are defined as the smallest unit of an element that still maintains the property of that element.	Carbon, Hydrogen, Oxygen
 Molecular Level	Atoms combine to form molecules which can have entirely different properties than the atoms they contain.	Water, DNA, Carbohydrates
 Cellular Level	Cells are the smallest unit of life. Cells are enclosed by a membrane or cell wall and in multicellular organisms often perform specific functions.	Muscle cell, Skin cell, Neuron
 Tissue Level	Tissues are groups of cells with similar functions	Muscle, Epithelial, Connective
 Organ Level	Organs are two or more types of tissues that work together to complete a specific task.	Heart, Liver, Stomach
 Organ System Level	An organ system is group of organs that carries out more generalized set of functions.	Digestive System, Circulatory System
 Organismal Level	An organism has several organ systems that function together.	Human

(<http://www.hartnell.edu/tutorials/biology/tissues.html>)

# Tissues

- Cells → Tissues → Organs → Systems of Organs → Organism
- Tissue: group of cells from the same origin, with similar shape carrying out a certain function together + extracellular matrix
- Types of tissues:
  1. Epithelial tissues
  2. Connective and supportive tissues
  3. Muscle tissues
  4. Nervous tissue



# Epithelial tissues

---

- Lining of all external and internal body surfaces.
- Derived from the external layer of the embryo (ectoderm).
- Epithelial cells are tightly packed together, no intercellular spaces, and only a small amount of intercellular substance.
- It is avascular (no blood vessels) → nutrients and oxygen come by absorption
- It is separated from the underlying tissue by a thin sheet of connective tissue=basement membrane. (structural support and also binds to neighboring structures).

## Types of Epithelial Tissue:

***according to shape:*** squamous, cuboidal, columnar (ciliated)

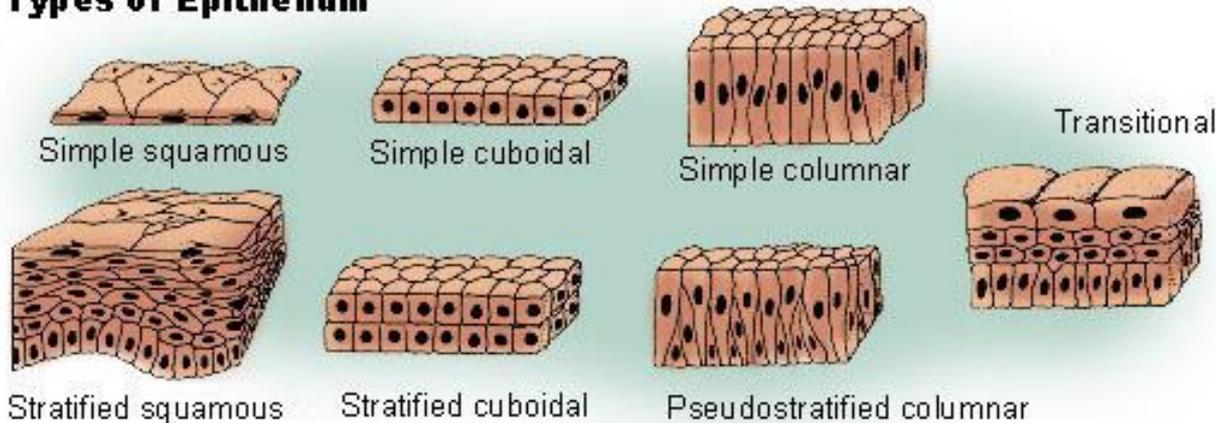
***according to layers:*** one or more

***according to function:*** lining, glandular, sensory, absorptive

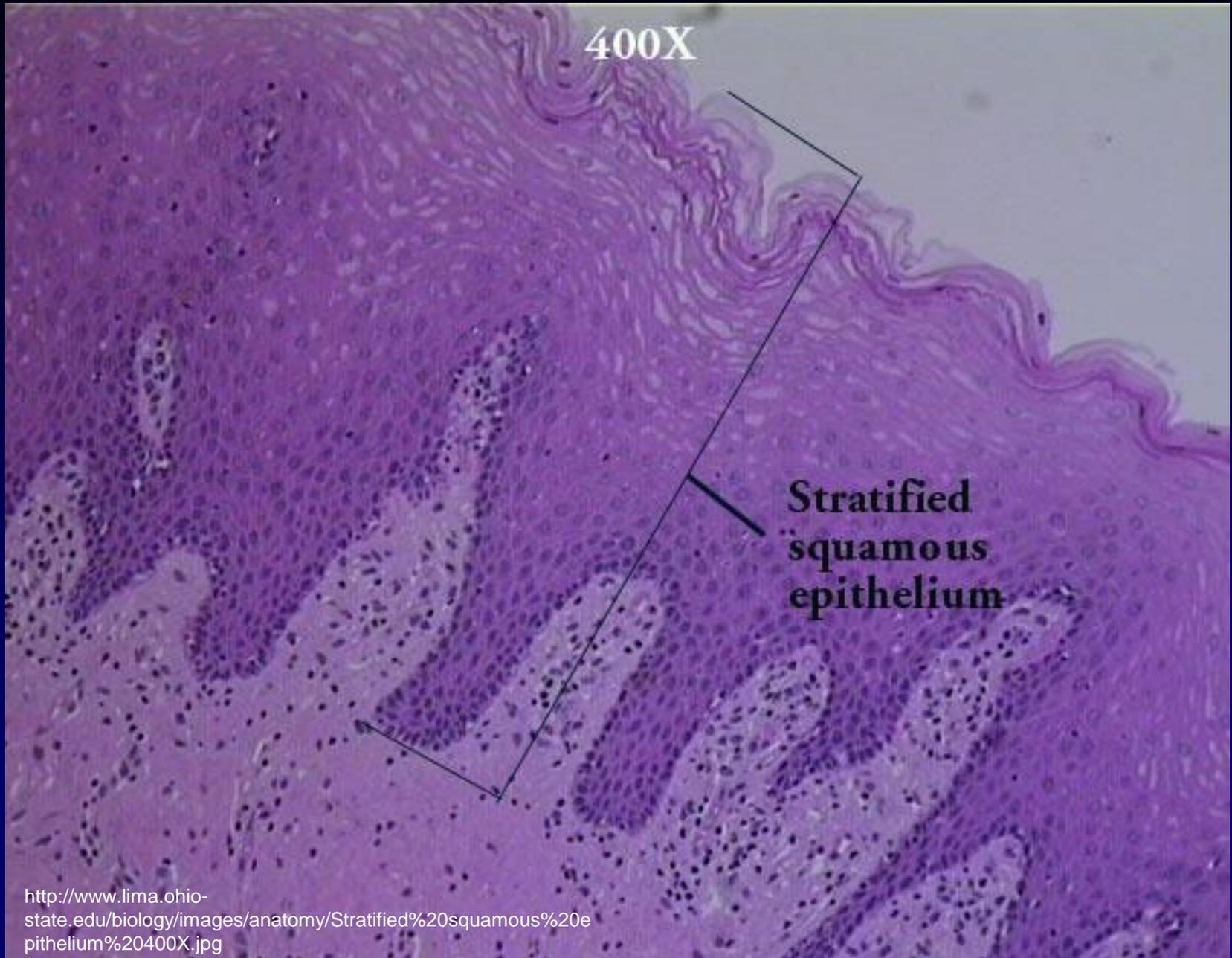
# Epithelial tissues

- Lining (surface) epithelia
  - Simple
    - a. Squamous (e.g. blood and lymphatic vessels; alveoli in lungs)
    - b. Cuboidal (e.g. kidney tubules)
    - c. Columnar (e.g. digestive tract. Can be ciliated: e.g. trachea and bronchi, here also pseudostratified)
  - Stratified : naming based on the upper layer:
    - a. Squamous:
      - Keratinized: skin
      - non-keratinized: esophagus, mouth, etc.
    - b. Cuboidal : e.g. sweat and salivary glands
    - c. Columnar: rare, male urethra and in large ducts of some glands
    - d. Transitional: can change from cuboidal to squamous (e.g. bladder)

## Types of Epithelium

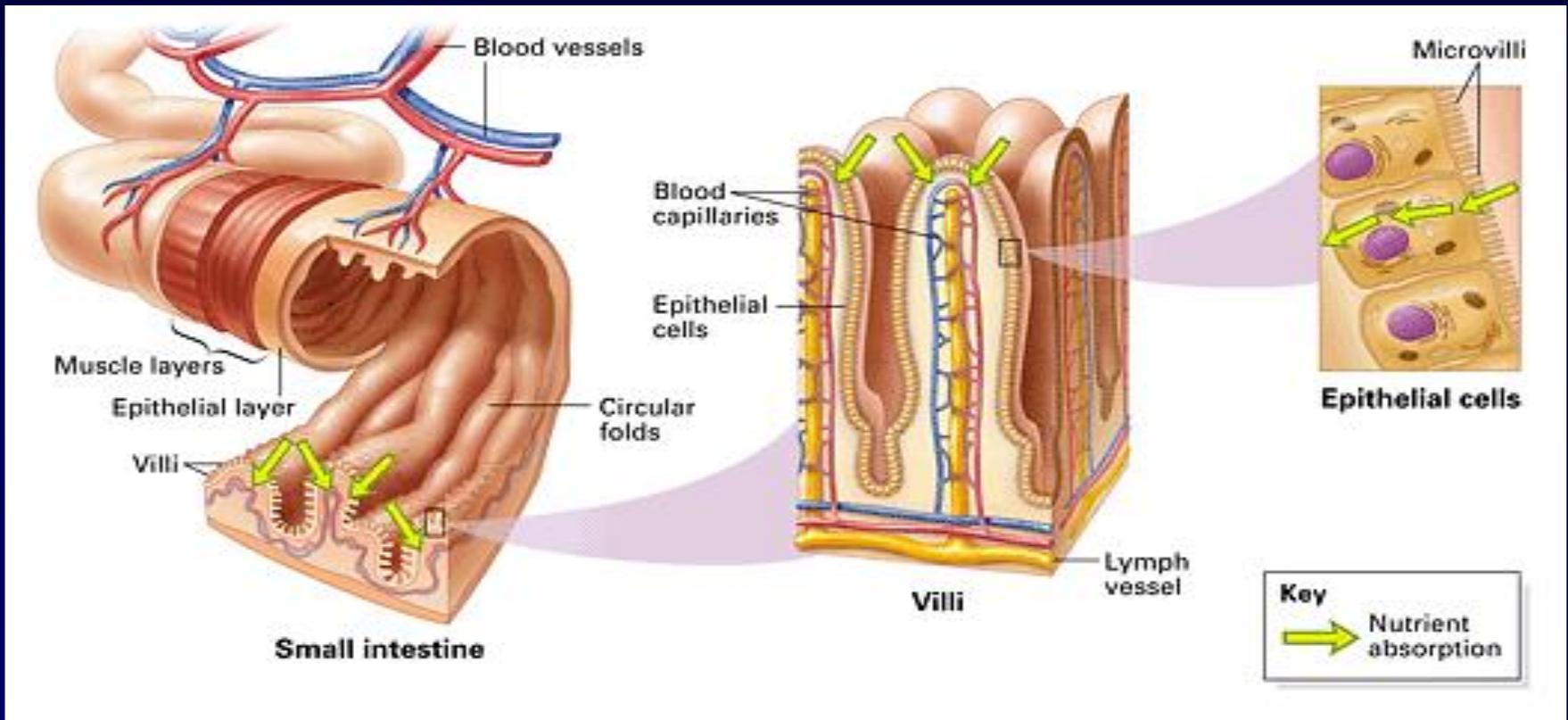


# Epithelial tissues



# Epithelial tissues

- Sensory (e.g. nose, tongue)
- Glandular
  - Exocrine (e.g.) sweat and digestive glands
  - Endocrine (hormones are produced)
- Others (e.g. absorptive in the small intestine)

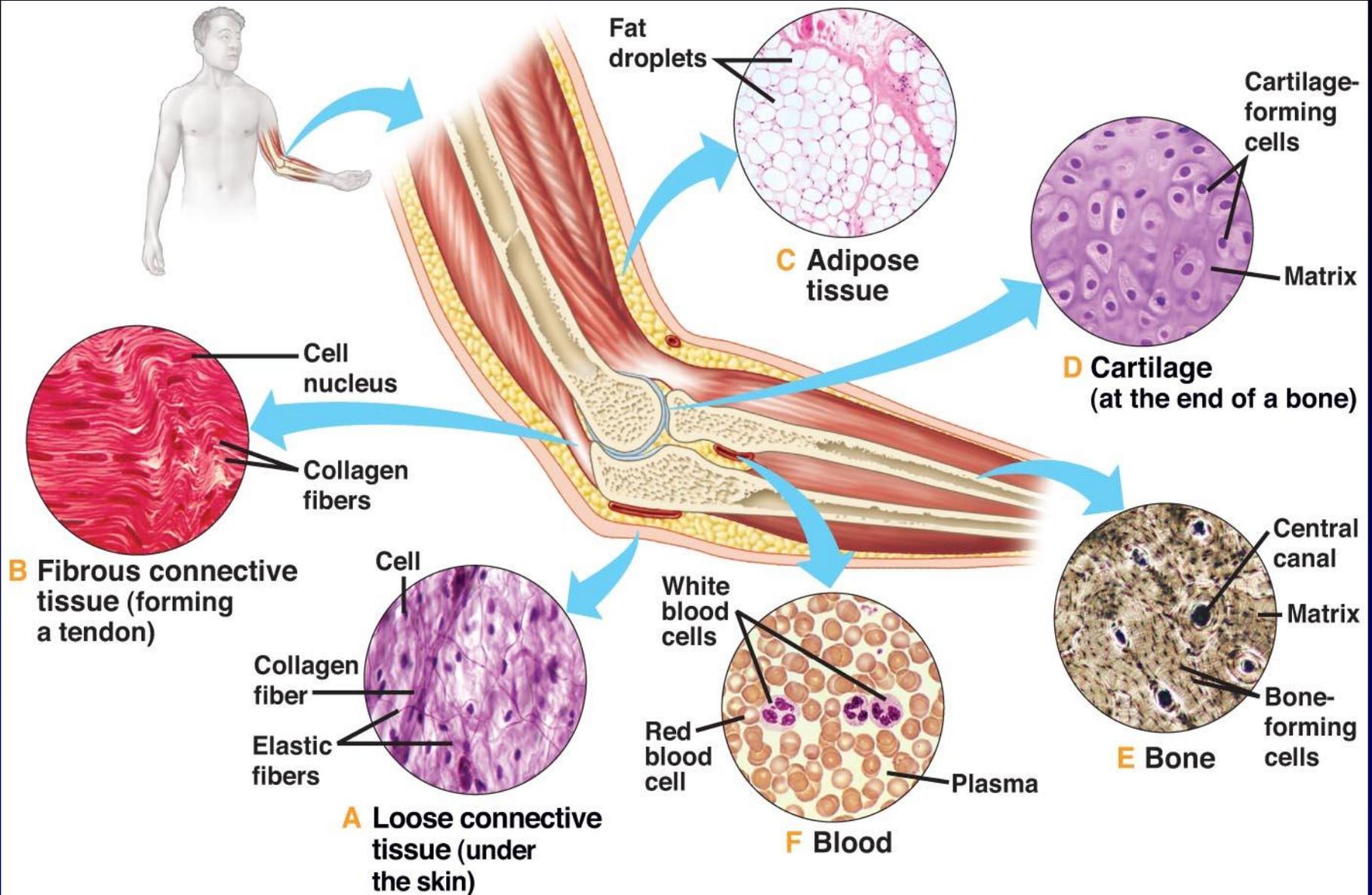


# Connective and supportive tissues

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- are the most diverse and abundant types of tissue
- support, anchor and connect - architectural framework and scaffold for the body and organs
- components:
  - Cells: produce the other two
  - Fibers: most commonly collagen for strength and elastic fibers for flexibility
  - intercellular substance (ground substance): varies, from gelatin-like to a much more rigid material.
- Types:
  - ❖ Connective Tissue Proper: e.g. adipose tissue (fat), areolar (loose) and dense connective tissue
  - ❖ Specialized Connective Tissues: blood, supportive tissues (cartilage, bone).

# Connective and supportive tissues



# Connective tissues

- Connective tissues (proper)

- Cell-rich connective tissues

- e.g. fat (adipose) tissue

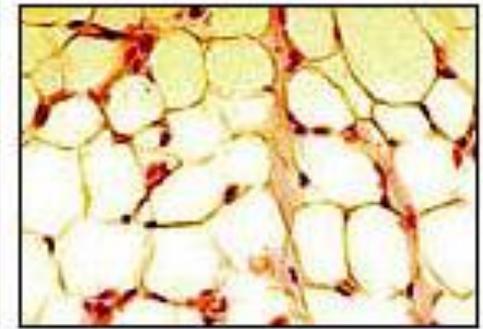
- Loose (areolar) e.g. in the subcutaneous layer of the skin

- Dense (fibrous)

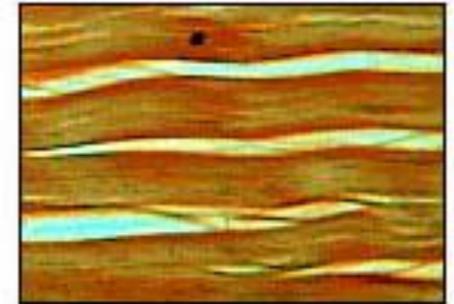
- ⇒ Collagenous (tendons, skin)

- ⇒ Elastic (some ligaments, large arteries)

- Reticular (lymphatic organs)



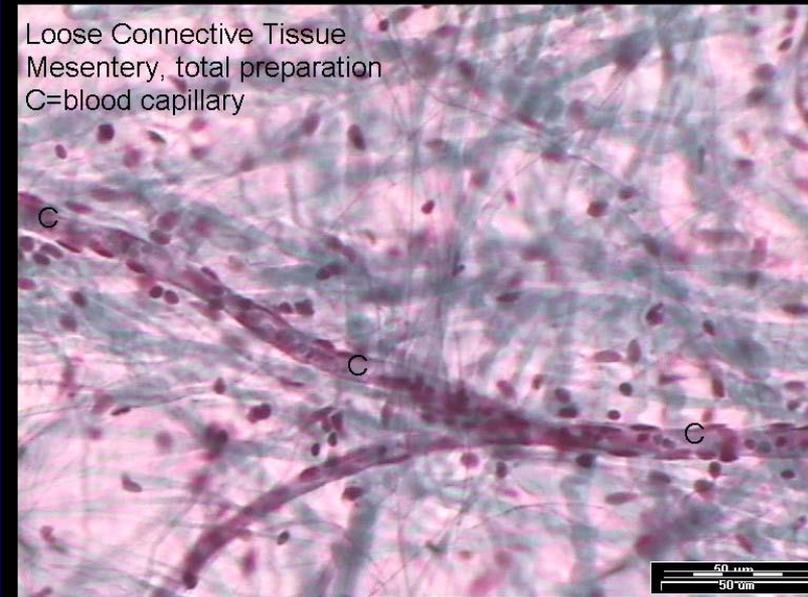
Adipose tissue



Fibrous connective tissue

[http://training.seer.cancer.gov/module\\_anatomy/images/illu\\_connective\\_tissues\\_1.jpg](http://training.seer.cancer.gov/module_anatomy/images/illu_connective_tissues_1.jpg)

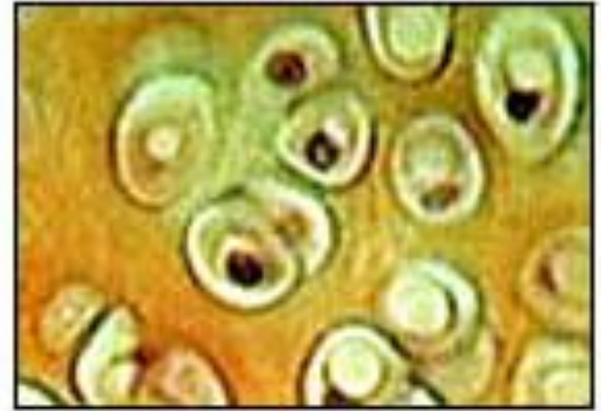
Loose Connective Tissue  
Mesentery, total preparation  
C=blood capillary



# Specialized connective tissues in a supportive role

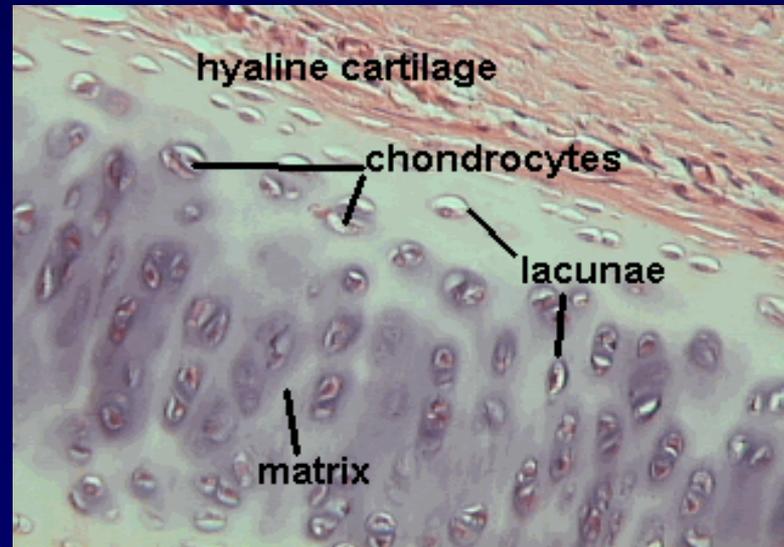
- Supportive tissues

- Cartilage: nose, trachea, bronchi, and the articulating surfaces of most joints
  - ⇒ Hyalin (joints)
  - ⇒ Collagen- or fibrocartilage (e.g. intervertebral discs)
  - ⇒ Elastic (ear)



Hyaline cartilage

[http://training.seer.cancer.gov/module\\_anatomy/unit2\\_2\\_body\\_tissues2\\_connective.html](http://training.seer.cancer.gov/module_anatomy/unit2_2_body_tissues2_connective.html)



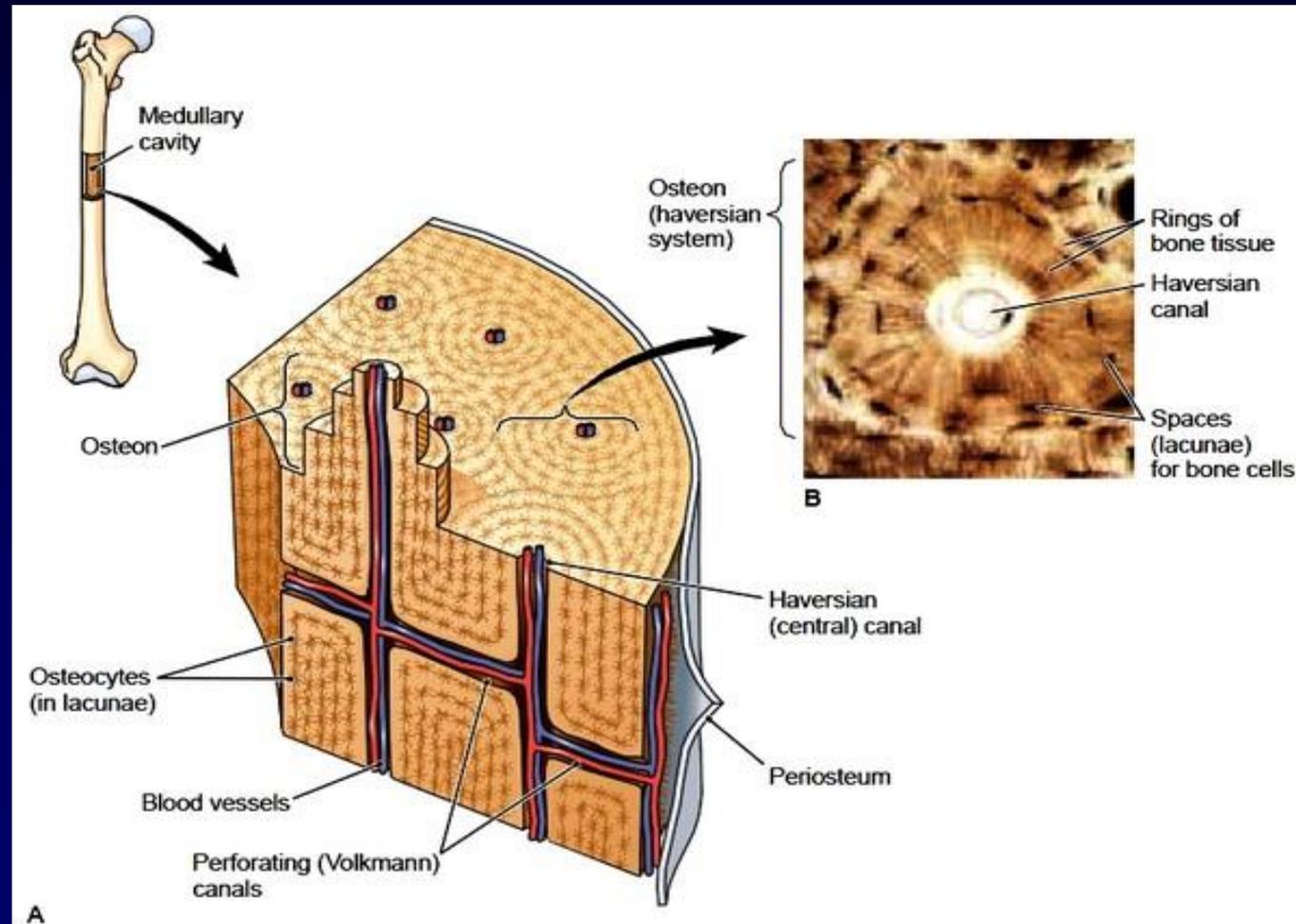
(<http://kentsimmons.uwinnipeg.ca/>)

# Specialized connective tissues in a supportive role

## ➤ Osseous tissue (bone)

Consists of osteocytes in concentric rings or thin columns. Collagen fibers are embedded in a hard mineral matrix of calcium, magnesium, and phosphate.

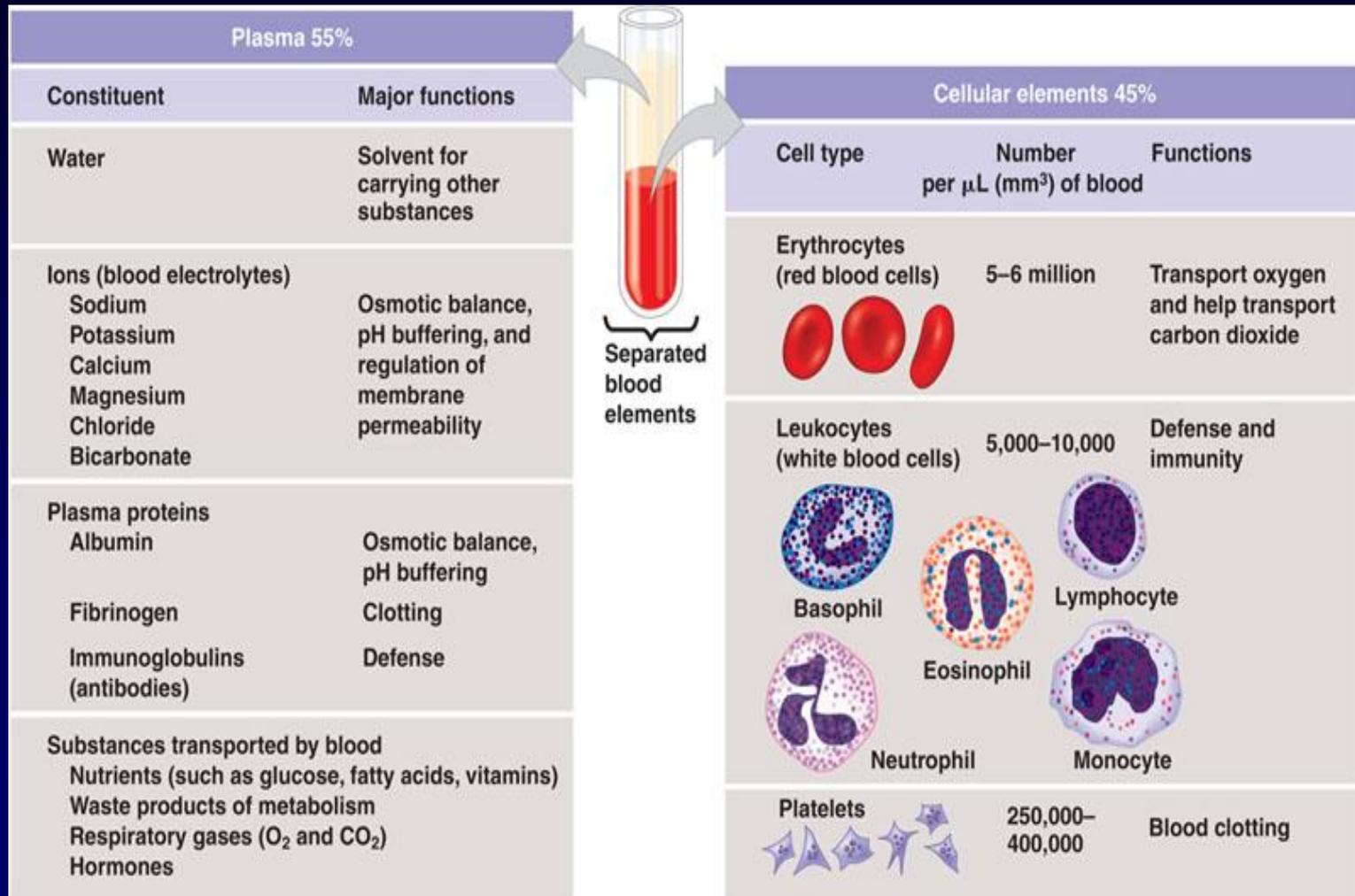
The two types of osseous tissue: compact (exterior) and spongy (interior).



# Specialized connective tissues: blood

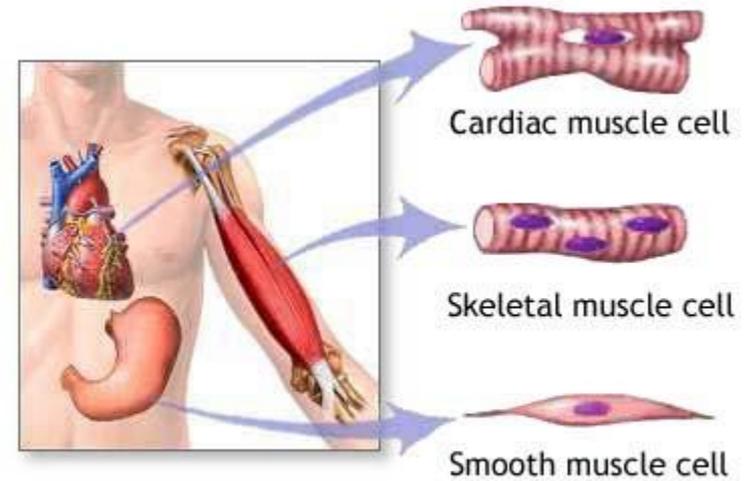
## ➤ Blood

delivers nutrients and oxygen to, and transports metabolic waste products away from cells. Also has roles e.g. in water balance, chemical signalling and immune response.



# Muscle (muscular) tissues

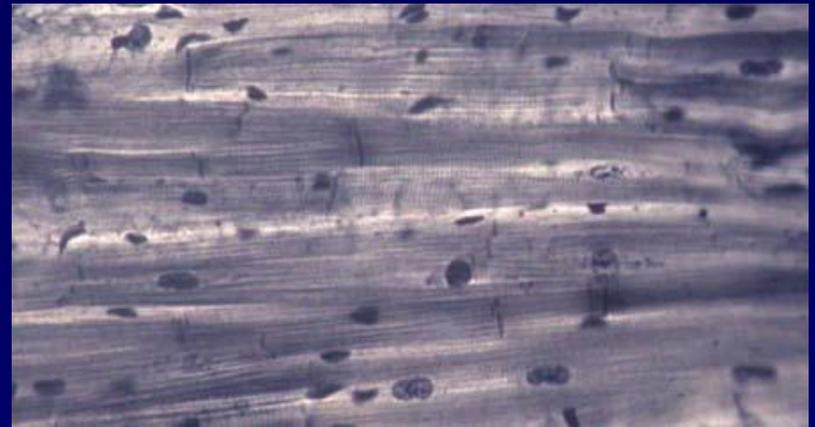
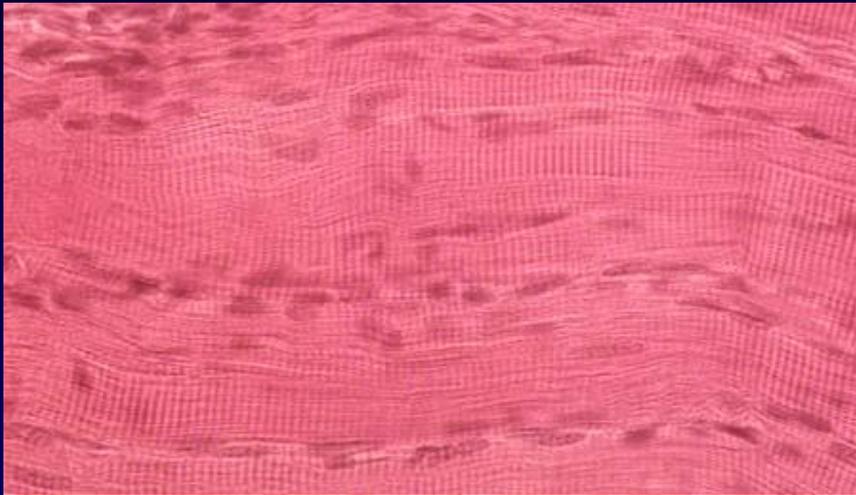
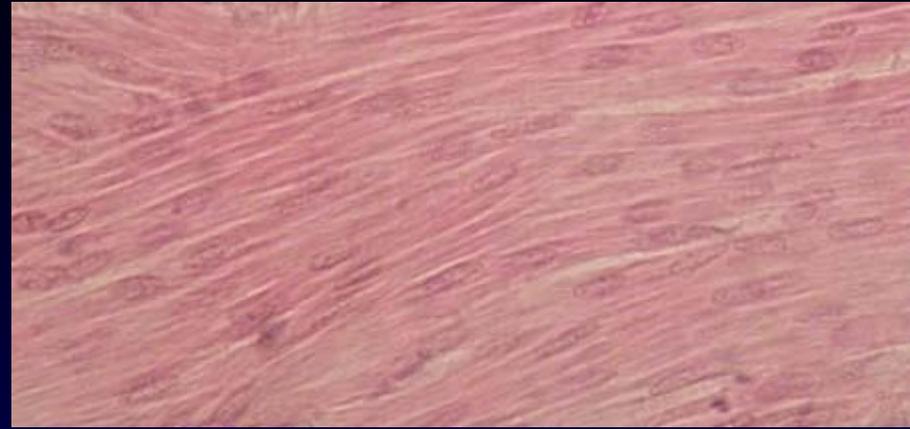
- Smooth
  - Smaller, separate cells
  - Central nucleus
  - Weaker, works for longer time, does not get tired
  - Internal organs
- Skeletal (striated)
  - Cells form huge myofibrils
  - Nucleus to the membrane
  - Stronger, for a shorter time, gets tired
  - Skeletal muscles
- cardiac (heart)
  - Cells similar to smooth muscle but form diverging fibers
  - Strong, works for a long time, does not get tired



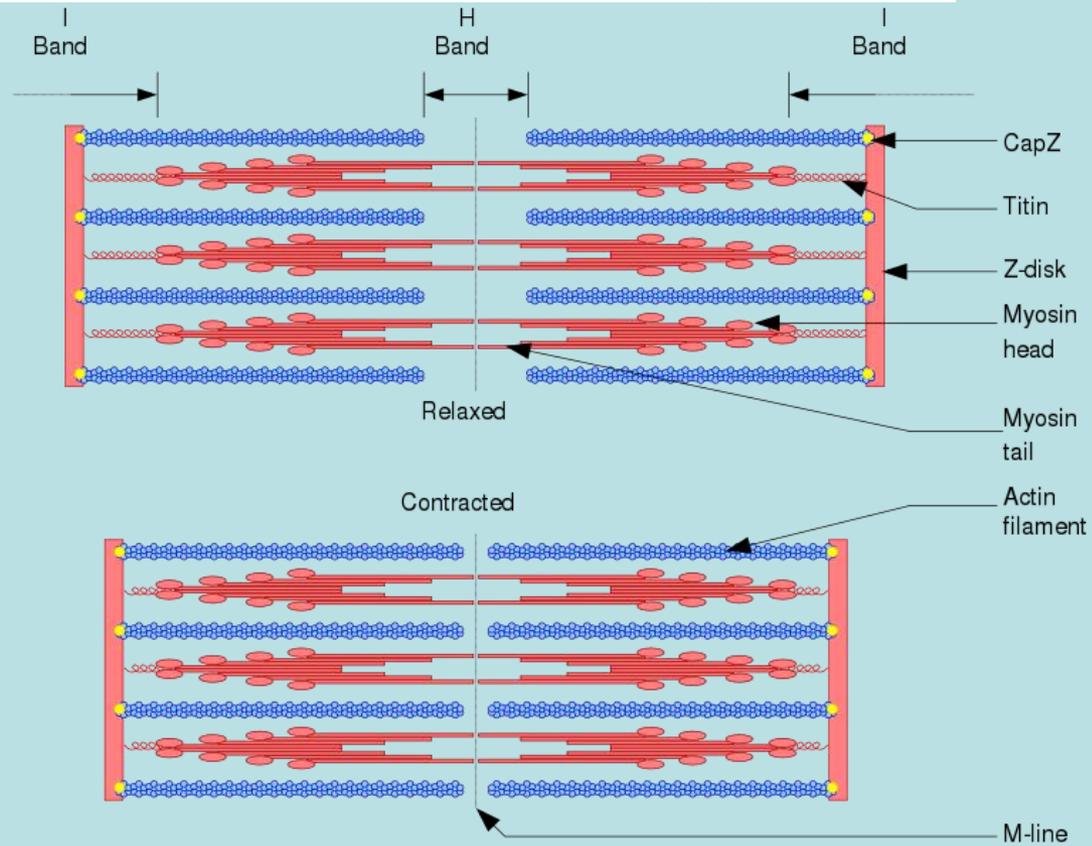
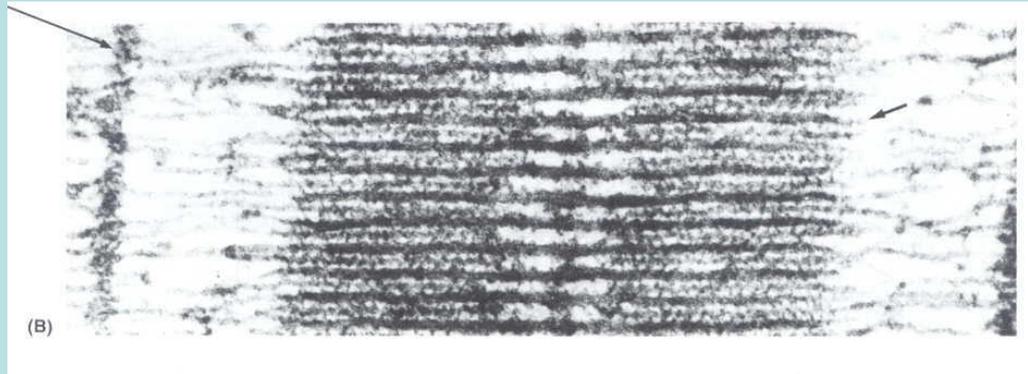
<http://graphics8.nytimes.com/images/2007/08/01/health/adam/19917.jpg>  
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# Muscle (muscular) tissues

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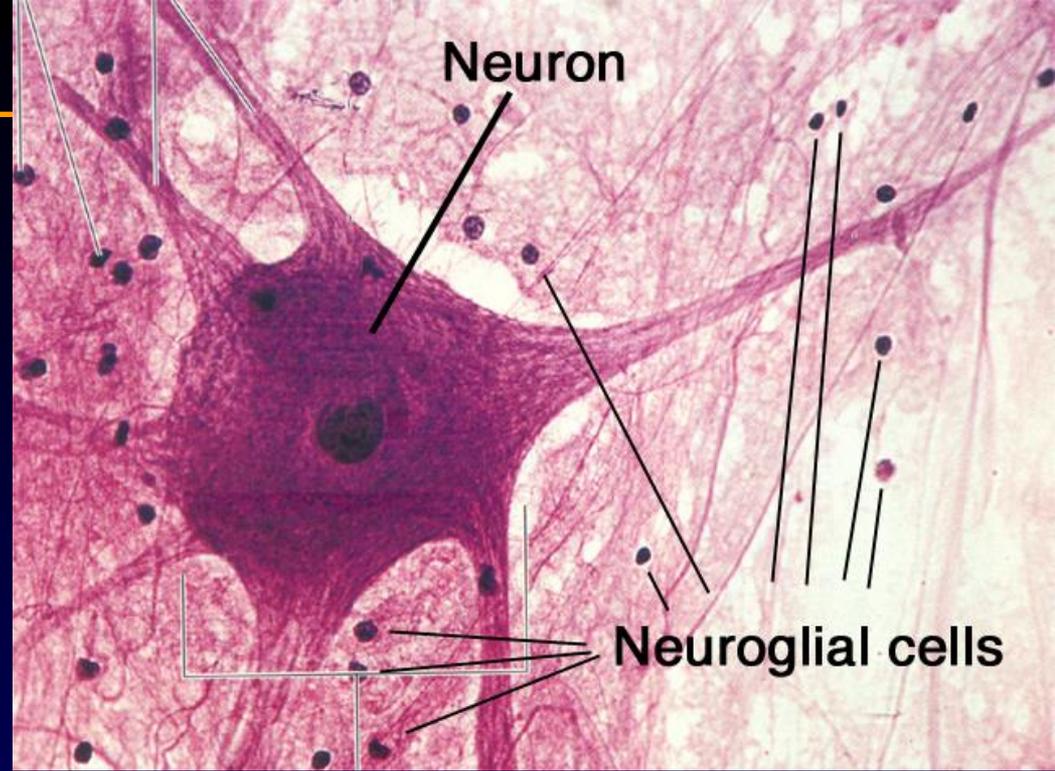


# Sarcomere

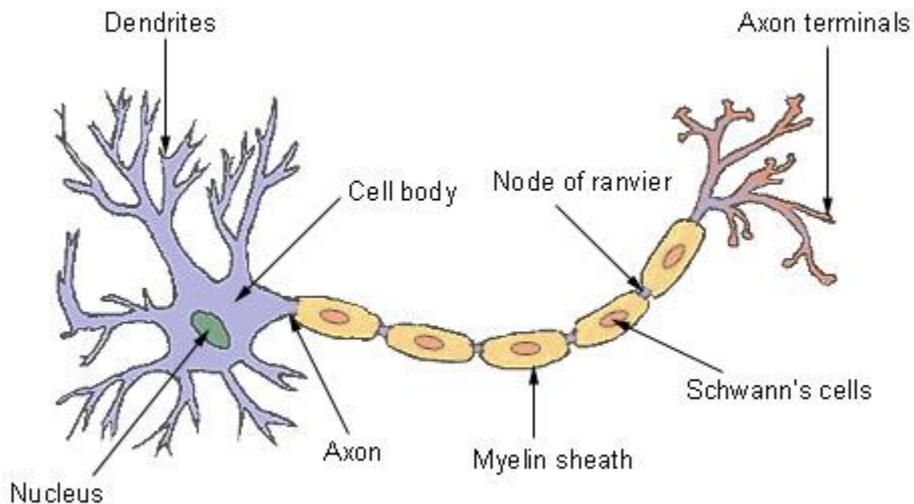


# Nervous tissue

- Neurons
- Glial cells (e.g. Schwann cells providing a myelin sheath)
- Other elements (connective tissue, blood etc)



**Structure of a Typical Neuron**



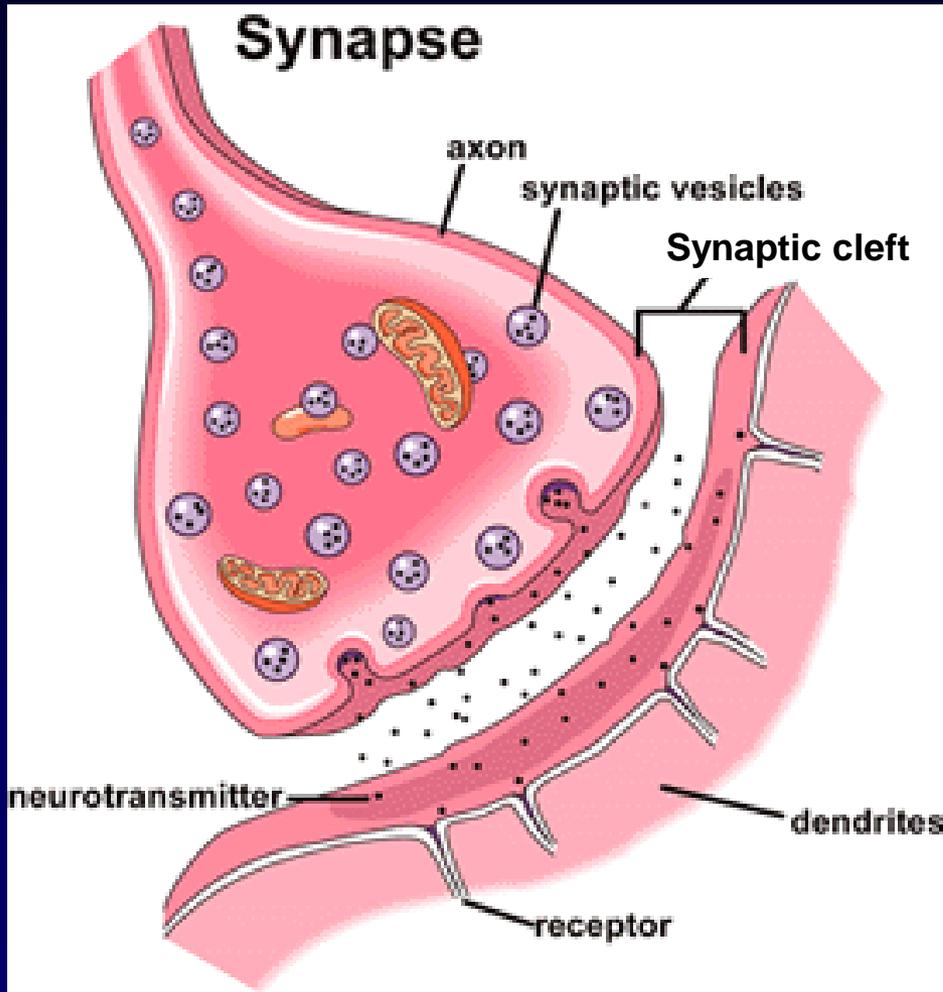
[www.hartnell.edu](http://www.hartnell.edu)

<http://www.training.seer.cancer.gov>

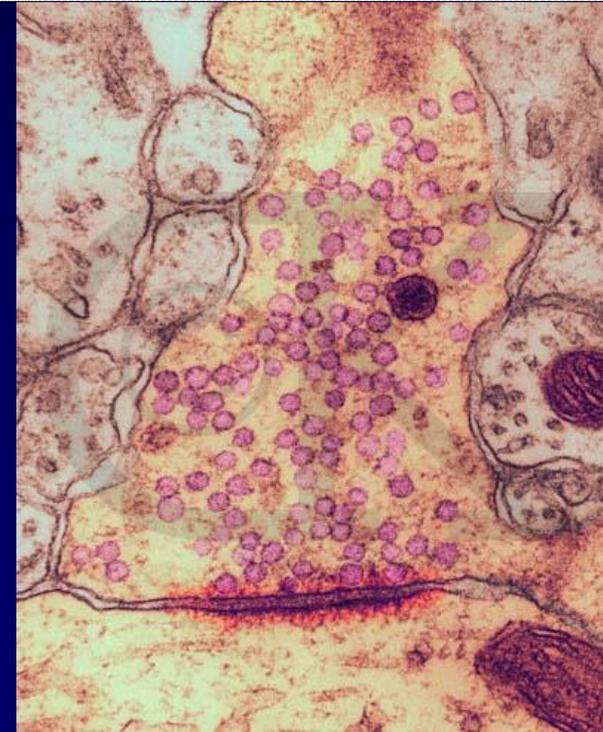
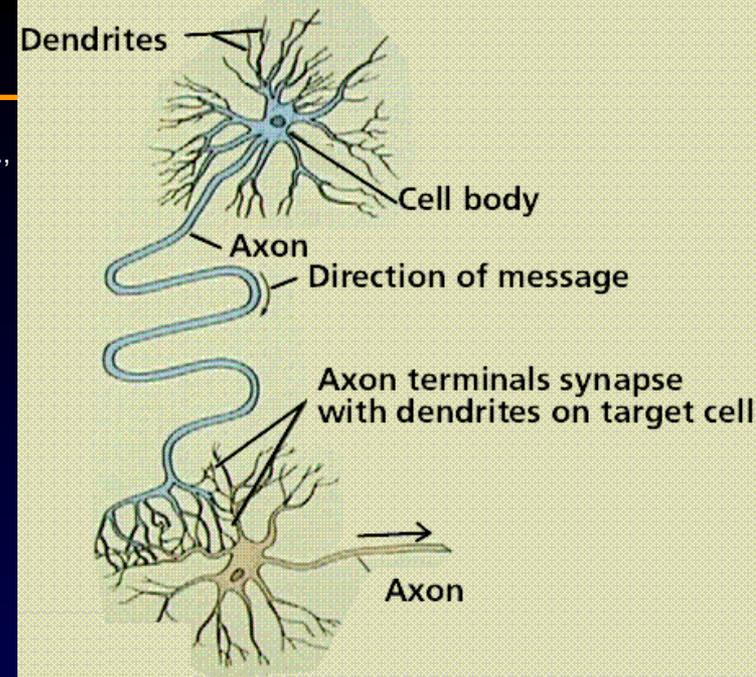
# Synapse

- Connection between neurons (or neuron-muscle cell)
- Synaptic cleft: 20-30 nm

<http://shp.by.ru/spravka/neurosci/synapse.gif>



Purves et al.,  
Life: The  
Science of  
Biology, 4th  
Edition



[www.DenniskUnkel.com](http://www.DenniskUnkel.com)

# Classification of neurons

- according to their function:
  - *sensory (or afferent)*
  - *motor (or efferent)*
  - *Interneurons*
- according to their structure:
  - *unipolar* - sensory neurons
  - *bipolar* neurons—motor neurons or interneurons
  - *multipolar* neurons: numerous processes (an axon and many dendrites) -interneurons

