

# **General histology**

# Objectives:

- By the end of this lecture, student should understand the 4 Basic types of tissues (Epithelial tissue, connective tissue, Muscle tissue , and nervous tissue.

- ❖ **Histology** : The study of cellular structures of the body
- ❖ Anatomy at the microscopic level (microanatomy)
- ❖ Cells---tissues---organs---organ systems
- ❖  $10^{15}$  cells in the human body
- ❖ 200+ cell types in the body

# Tissue Level of Organization

Tissues are groups of similar cells and extracellular products that carry out a common function.

❖ **Biopsy:** removal of tissues for diagnostic purposes

❖ **Autopsy:** examination of organs of a dead body to determine cause of death

# The 4 Basic types of tissues

- ❖ **Epithelial tissue** (covering)
- ❖ **Connective tissue** (support)
- ❖ **Muscle tissue** (movement)
- ❖ **Nervous tissue** (control)



**Most organs contain all 4 types**

# Epithelial tissue

# Functions of Epithelia

- Protecting underlying structures; e.g., epithelium lining the mouth
- Acting as barriers; e.g., skin
- Secreting substances; e.g., pancreatic cells
- Absorbing substances; e.g., lining of stomach and small intestine
- Continuously supply information to the nervous system concerning pressure, temperature, and pain.



# Classification of Epithelium

(i) According to the number of layers of cells:

- ❖ **Simple Epithelium** : one layer of cells.
- ❖ **Stratified Epithelium** : more than one layer.

## (ii) According to the shape of cells:

- ❖ **Squamous Epithelium** : flat
- ❖ **Cuboidal Epithelium** : about equal in height and width
- ❖ **Columnar Epithelium** : taller than wide

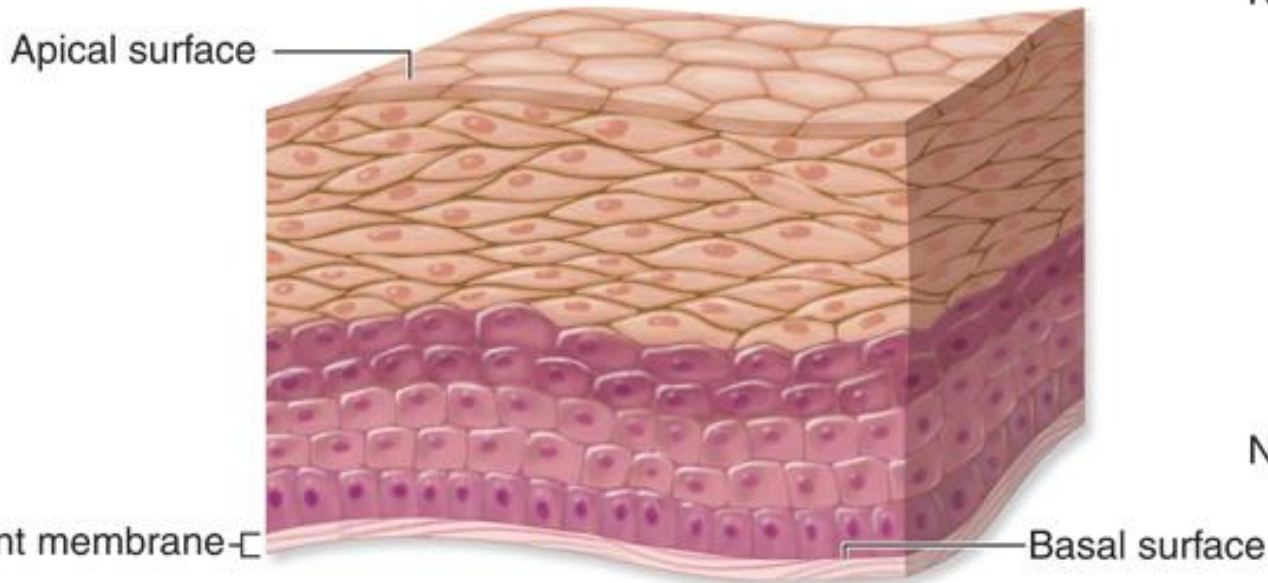
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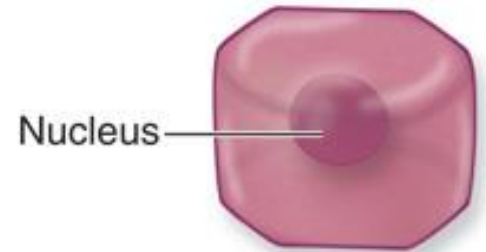
**Simple epithelium**



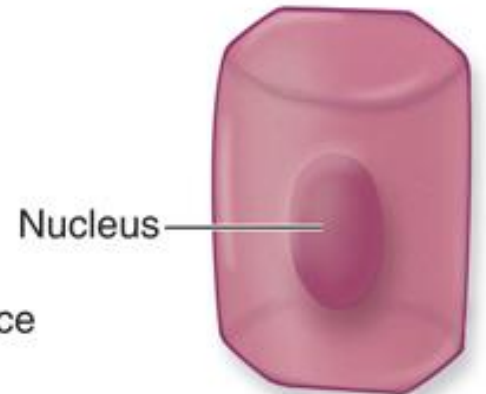
**Squamous cell**



**Stratified epithelium**



**Cuboidal cell**



**Columnar cell**

(a)

(b)

### Simple squamous

- Lines blood vessels and air sacs of lungs
- Permits exchange of nutrients, wastes, and gases



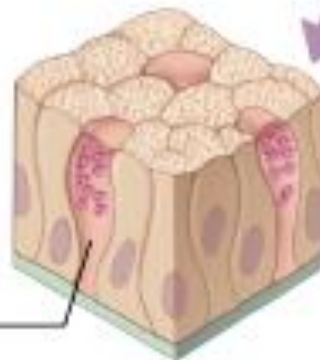
### Simple cuboidal

- Lines kidney tubules and glands
- Secretes and reabsorbs water and small molecules



### Simple columnar

- Lines most digestive organs
- Absorbs nutrients, produces mucus



Goblet cell

### Stratified squamous

- Outer layer of skin, mouth, vagina
- Protects against abrasion, drying out, infection



### Stratified cuboidal

- Lines ducts of sweat glands
- Secretes water and ions



### Stratified columnar

- Lines epididymus, mammary glands, larynx
- Secretes mucus



Basement membrane

(a) Most epithelial tissues line or cover surfaces or body cavities

# Stratified Epithelia

- ❖ Contain two or more layers of cells
- ❖ Regenerate from below
- ❖ Major role is protection
- ❖ Are named according to the shape of cells at apical layer.

# Stratified Squamous Epithelium

## Description

- Many layers of cells
- Apical layer of cells appear squamous in shape
- Deeper layers of cells appear cuboidal or columnar
- Thickest epithelial tissue , adapted for protection

# Stratified Squamous Epithelium

## Specific types:

❖ **Keratinized** : contain the protective protein keratin.

- Surface cells are dead and full of keratin

❖ **Non-keratinized** : forms moist lining of body openings.

# Stratified Squamous Epithelium

## Location:

- ❖ Keratinized : forms epidermis
- ❖ Non-keratinized : forms lining of esophagus, mouth, and vagina



### Simple squamous

- Lines blood vessels and air sacs of lungs
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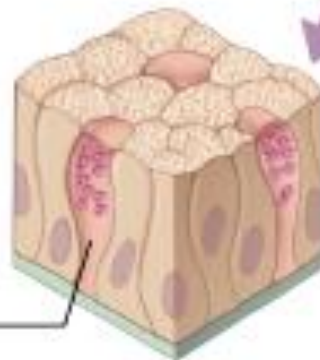
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Basement membrane

(a) Most epithelial tissues line or cover surfaces or body cavities

# Stratified cuboidal and columnar epithelia

- ❖ Are not common.
- ❖ Stratified cuboidal epithelium is, for example, seen in the ducts of the sweat glands.
- ❖ Stratified columnar epithelia are found in the excretory ducts of the mammary gland and the main excretory duct of the large salivary glands.

# Connective Tissue

# Connective Tissue

- Most diverse, abundant, widely distributed tissues.
- Designed to support, protect, and bind organs and body structures together.

# Basic Components of CT

All CT share three basic components:

❖ Cells

❖ Protein fibers

❖ Ground substance

# Connective Tissue Cells

- **Fibroblasts** - secrete the proteins needed for fiber synthesis and components of the extracellular matrix
- **Adipose or fat cells (adipocytes)**. Common in some tissues (dermis of skin)
- **Mast cells**. Common beneath membranes; along small blood vessels. Can release heparin, histamine, and proteolytic enzymes in response to injury.
- **Leukocytes (WBC's)**. Respond to injury or infection
- **Macrophages**. Derived from monocytes (a WBC). Phagocytic; provide protection
- **Chondroblasts** - form cartilage
- **Osteoblasts** - form bone
- **Undifferentiated mesenchyme** (stem cells). Have potential to differentiate into adult cell types.

# Connective Tissue Fibers

- Strengthen and support connective tissue.
- Type and abundance of these fibers varies depending on function.

# Types of C.T Fibers

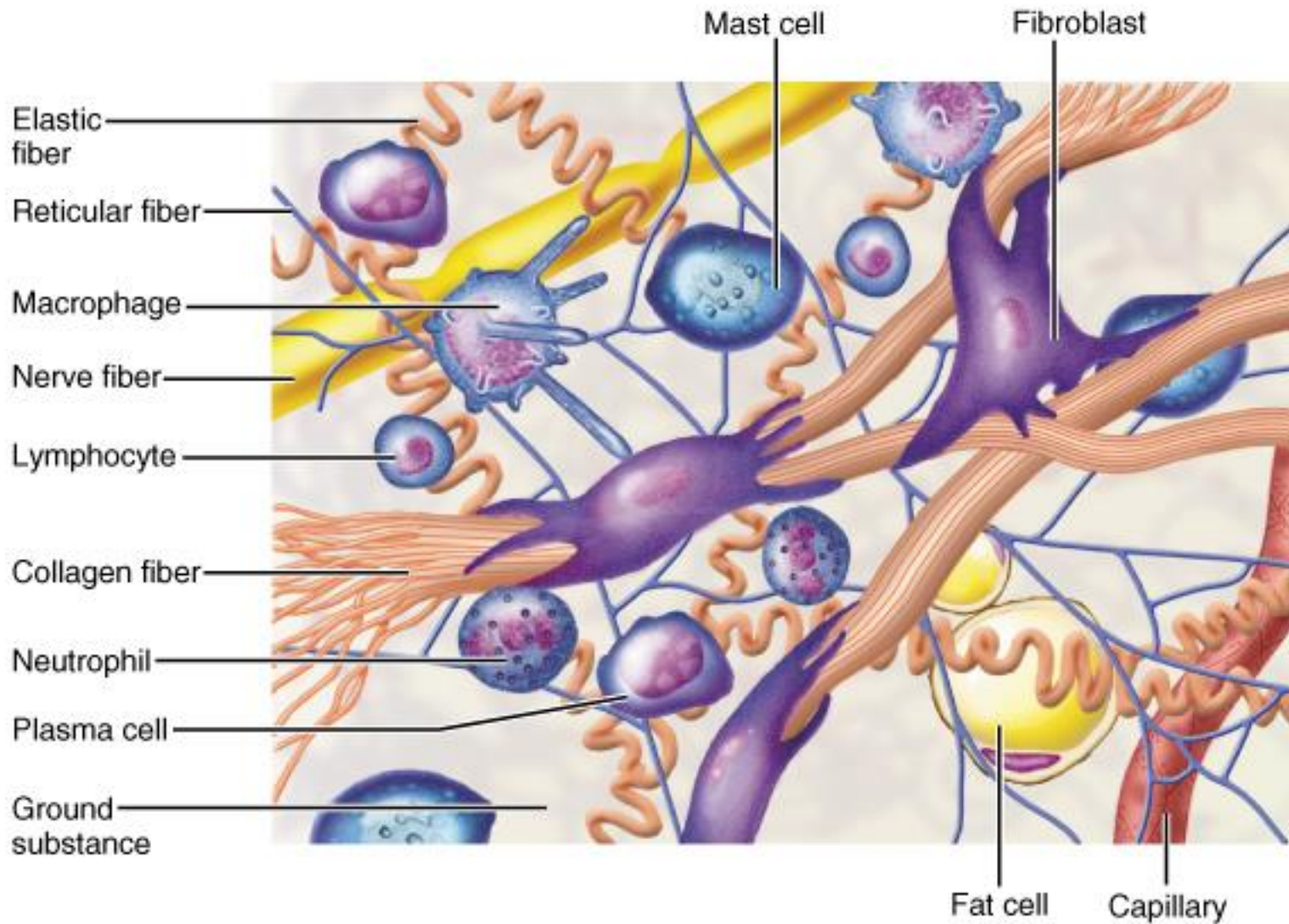
Three basic types of protein fibers:

❖ **Collagen fibers** are strong and stretch-resistant

❖ **Elastic fibers** are flexible and resilient

❖ **Reticular fibers** form an interwoven framework





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# Connective Tissue Ground Substance

- ❖ Cells and the protein fibers reside within a material called **ground substance**.
- ❖ **Nonliving material** produced by the connective tissue cells.
- ❖ Primarily consists of molecules composed of **protein** and **carbohydrate** and variable amounts of water.
- ❖ May be viscous (blood), semisolid (cartilage), or solid (bone).

# Muscle Tissue

# Muscle Tissue

- Responds to stimulation from the nervous system causing them to shorten.
- Produce voluntary and involuntary movement.

# Types of muscle

## **A. skeletal muscle** (attached to bones):

- ❖ Striated in appearance under microscope.
- ❖ Cells are unbranched and are multinucleated syncytia.
- ❖ These muscles are capable of voluntary, quick, forceful contractions.

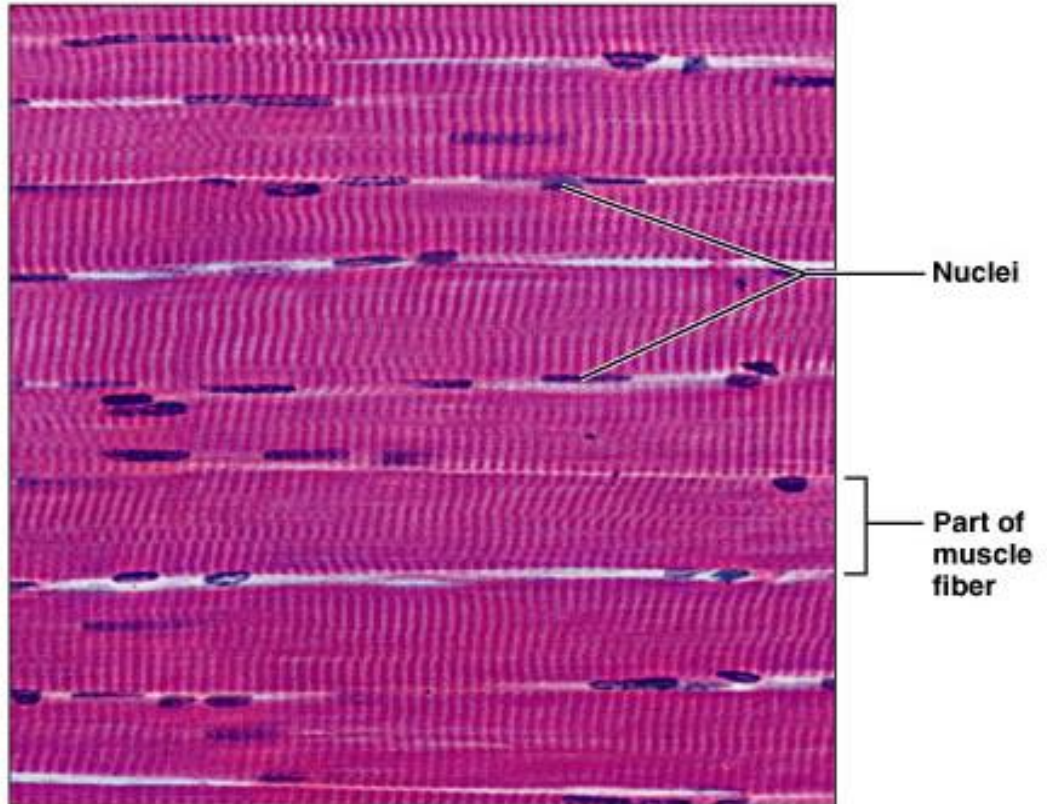
# Skeletal Muscle Tissue

## (a) Skeletal muscle

**Description:** Long, cylindrical, multinucleate cells; obvious striations.

**Function:** Voluntary movement; locomotion; manipulation of the environment; facial expression; voluntary control.

**Location:** In skeletal muscles attached to bones or occasionally to skin.



**Photomicrograph:** Skeletal muscle (approx. 300 $\times$ ). Notice the obvious banding pattern and the fact that these large cells are multinucleate.

## B. Cardiac muscle :

- ❖ Heart muscle, striated, cells may be branched.
- ❖ Cardiac muscle cells are either mono- or binucleate cells.
- ❖ Cardiac muscle is capable of involuntary, strong, contractions



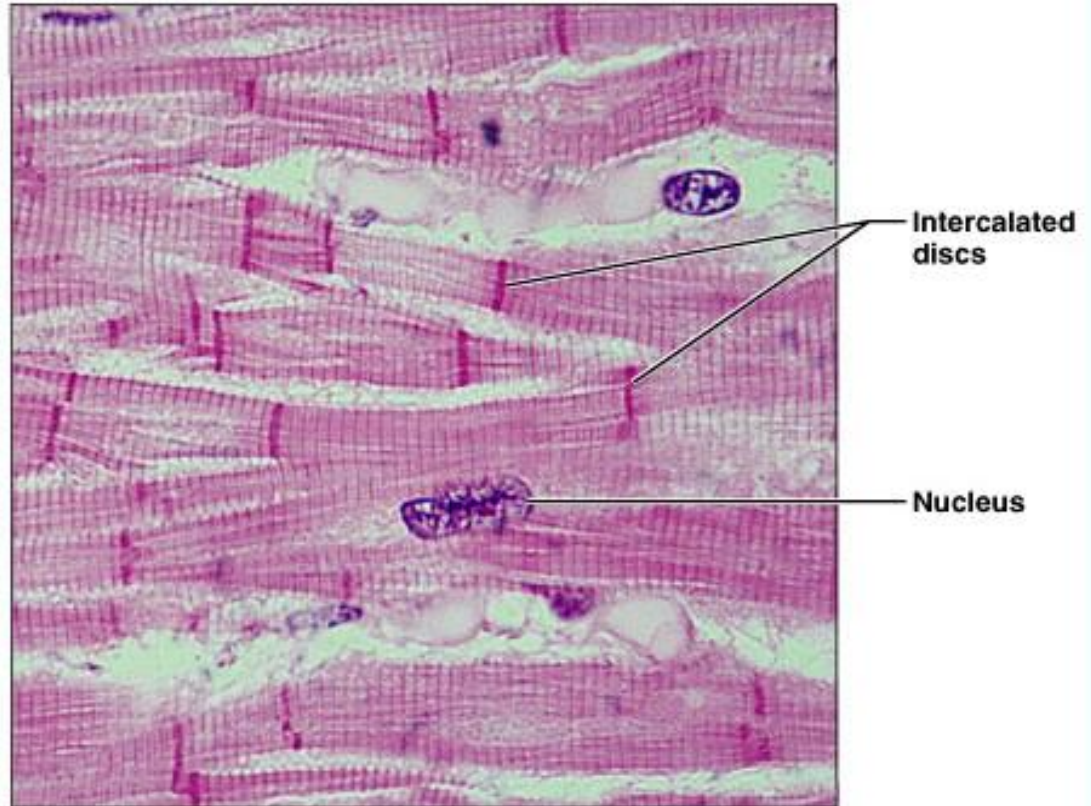
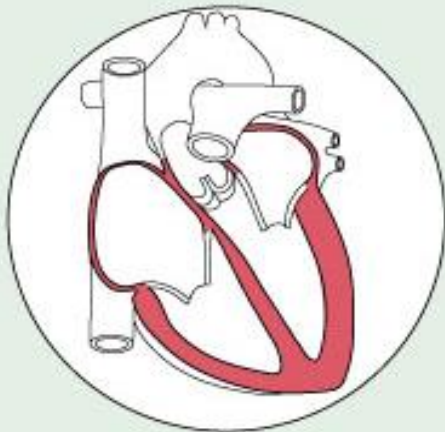
# Cardiac Muscle Tissue

## (b) Cardiac muscle

**Description:** Branching, striated, generally uninucleate cells that interdigitate at specialized junctions (intercalated discs).

**Function:** As it contracts, it propels blood into the circulation; involuntary control.

**Location:** The walls of the heart.



**Photomicrograph:** Cardiac muscle (800 $\times$ ); notice the striations, branching of cells, and the intercalated discs.



## C. Smooth muscle :

- ❖ This muscle is not striated, involuntary and is found in the walls of the visceral organs.
- ❖ Mononucleate cells.
- ❖ These muscle cells are capable of relatively slow contractions as compared to those of skeletal or cardiac muscle.

# Smooth Muscle Tissue

## (c) Smooth muscle

**Description:** Spindle-shaped cells with central nuclei; no striations; cells arranged closely to form sheets.

**Function:** Propels substances or objects (foodstuffs, urine, a baby) along internal passageways; involuntary control.

**Location:** Mostly in the walls of hollow organs.



Smooth muscle cell  
Nuclei

**Photomicrograph:** Sheet of smooth muscle (approx. 600 $\times$ ).

# **Nervous Tissue**

# Nervous Tissue

- ❖ Sometimes termed neural tissue.
- ❖ Consists of neurons, or nerve cells, and glial cells that support, protect, and provide a framework for neurons.

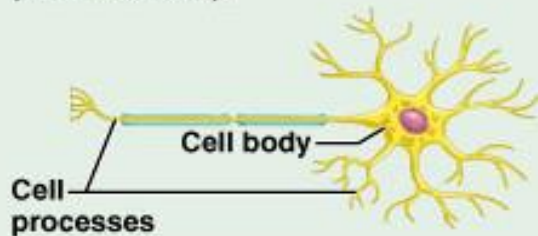
# Neurons

- ❖ Detect stimuli, process information quickly, and rapidly transmit electrical impulses from one region of the body to another.
- ❖ Prominent cell body functions in control; information processing, storage, and retrieval; internal communication.

# Neurons

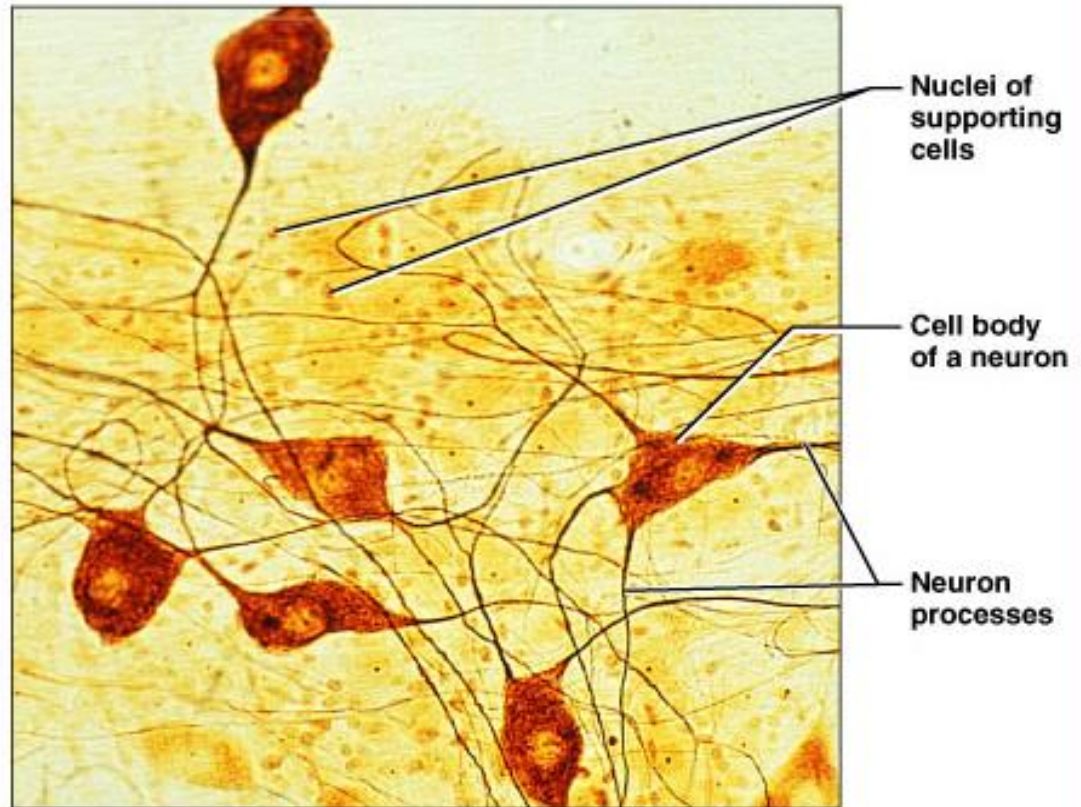
## Nervous tissue

**Description:** Neurons are branching cells; cell processes that may be quite long extend from the nucleus-containing cell body; also contributing to nervous tissue are nonirritable supporting cells (not illustrated).



**Function:** Transmit electrical signals from sensory receptors and to effectors (muscles and glands) that control their activity.

**Location:** Brain, spinal cord, and nerves.



**Photomicrograph: Neurons (100x)**



# Thank you

