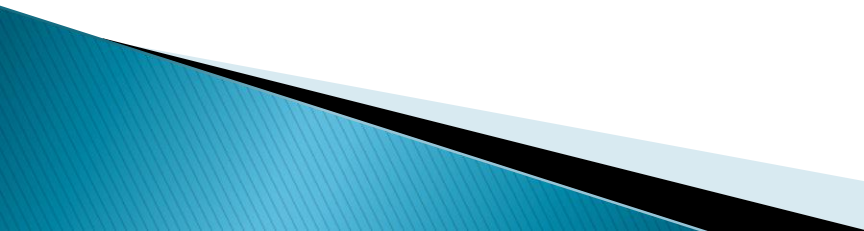
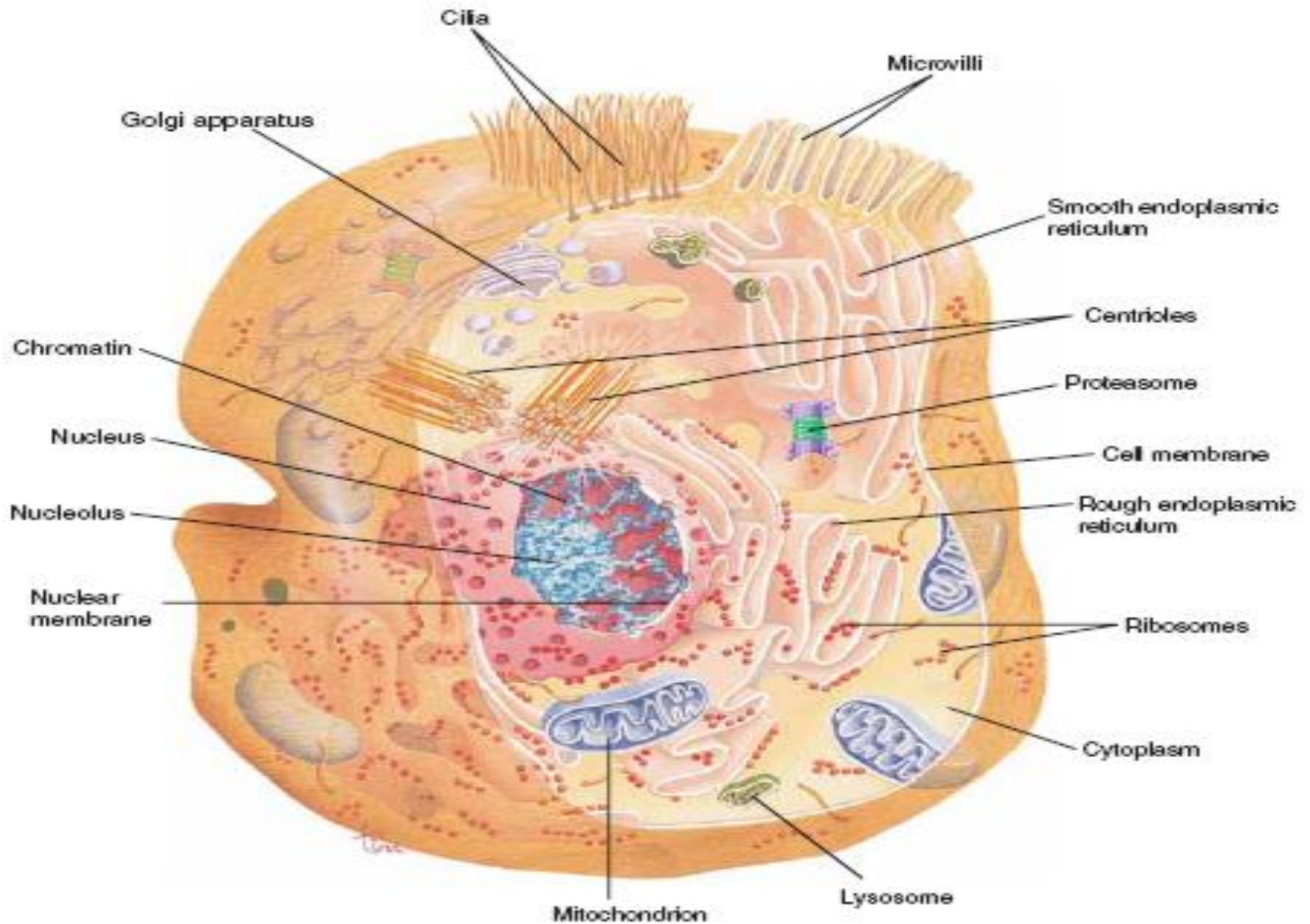


# Introduction to Basic Histology

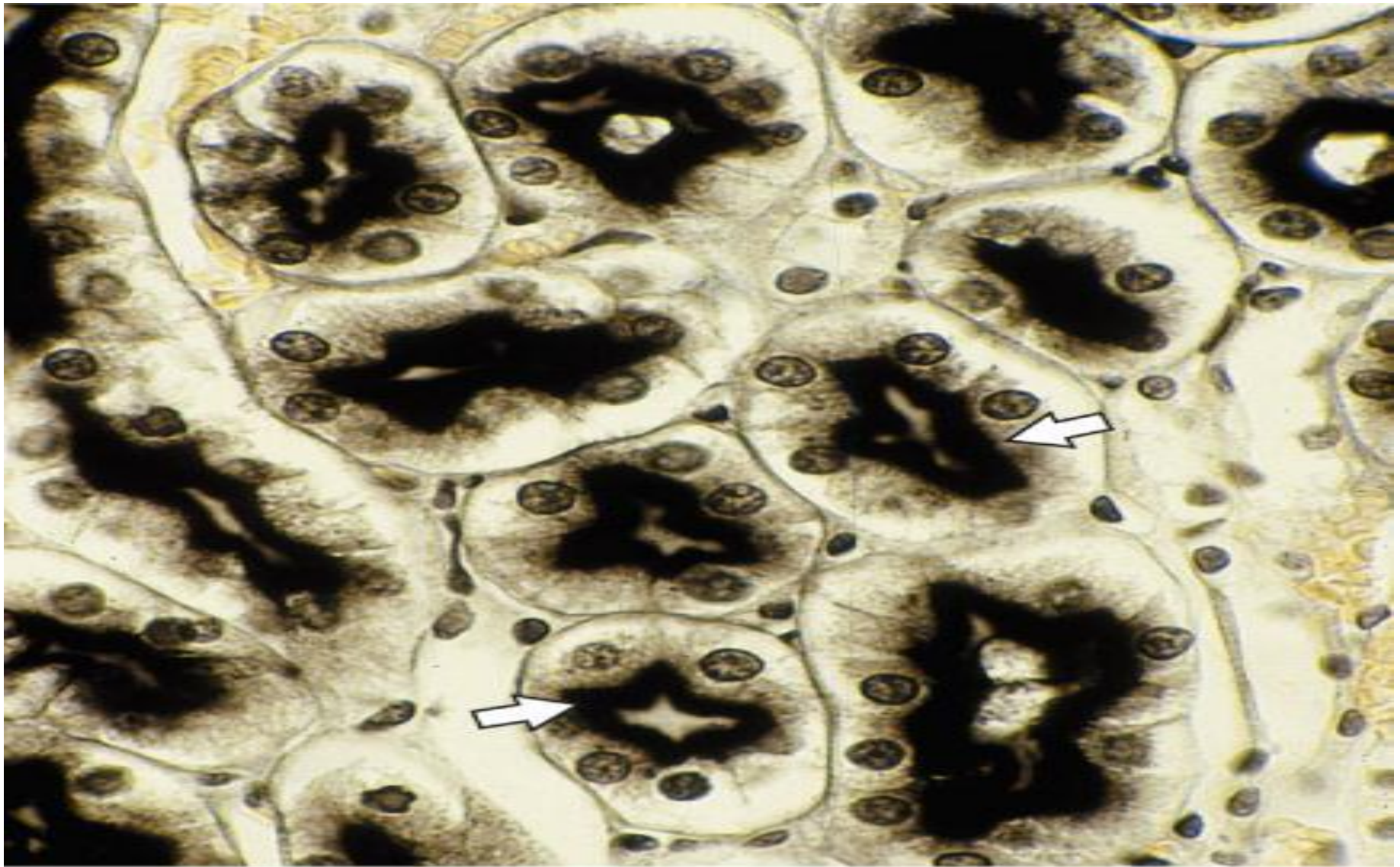
*Dr. Rajaa Ali*

# Level of Organization

- ▶ Cell – most basic unit structure of life.
  - ▶ Unicellular life forms – perform and carry out life processes
  - ▶ Multicellular – group of cells, perform more complex life processes, different cells are present, performing a certain function.
  - ▶ Tissue – a group of cells sharing the same function. (Ex: liver tissue – hepatocyte – hepatic tissue or liver parenchyma)
  - ▶ Tissues can be arranged as compact tissue – Organ
- 



▶ Typical human cell depicting the structural components. (Davis, 2007)



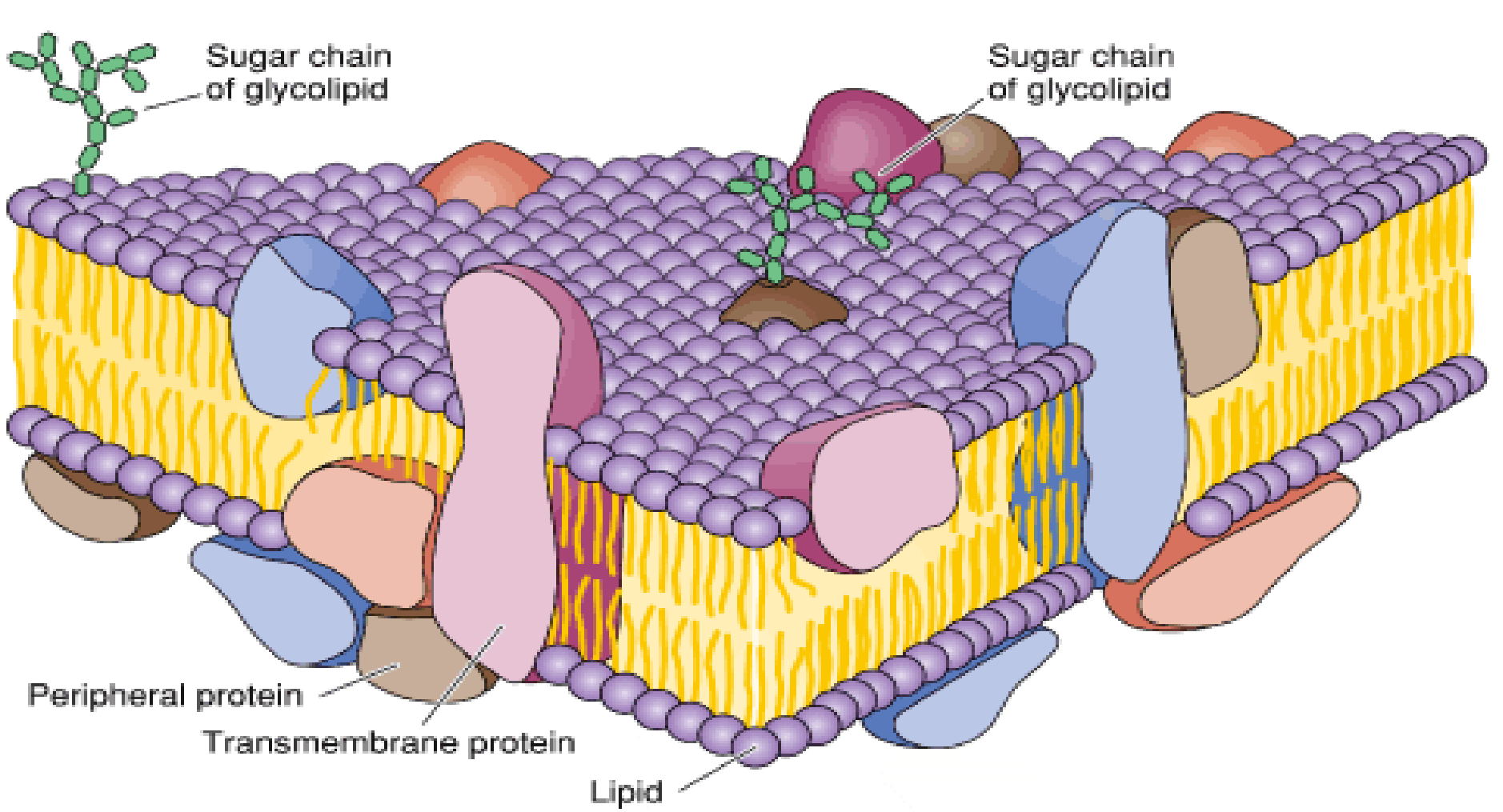
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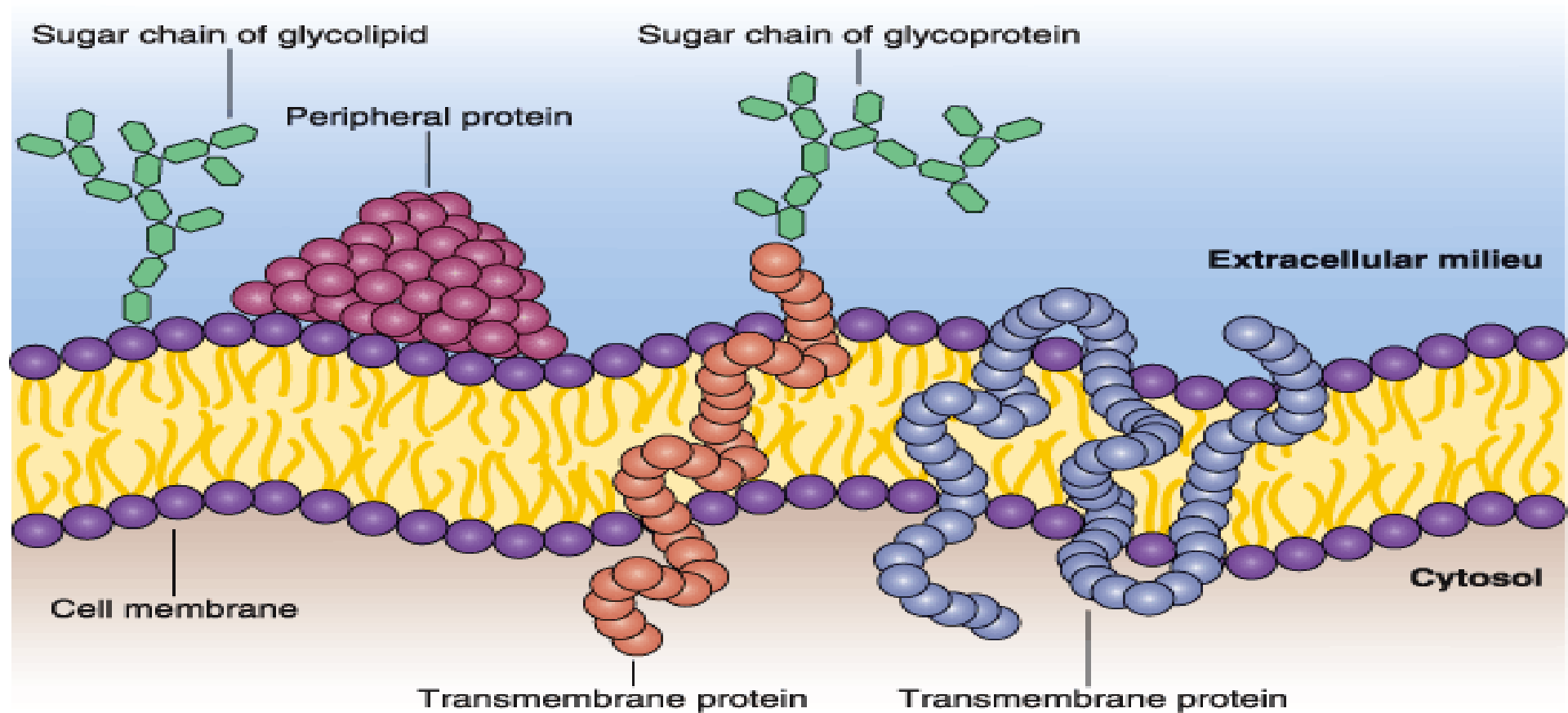
Photomicrograph of a **rat kidney** section treated by the Gomori method to demonstrate the enzyme alkaline phosphatase covered by a black precipitate (arrows). Medium magnification.

# Tissue components :

## Cells and Extracellular Matrix

- ▶ Extracellular matrix (ECM) consists of many molecules, which are highly organized and form complex structures like collagen fibrils and basement membranes.
- ▶ ECM functions:
  - A. To furnish mechanical support for the cells,
  - B. To transport nutrients to the cells, and
  - C. To carry away catabolites and secretory products.
  - Note: Cells not only produce extracellular matrix components but are also influenced by them creating an intense interaction between cells and matrix.
- ▶ Many molecules of the matrix are recognized by and attach to **receptors** present on cell surfaces. These receptors cross the cell membranes and connect to molecules within the cytoplasm. Thus, cells and ECM form a continuum that works together and reacts to stimuli and inhibitors together.

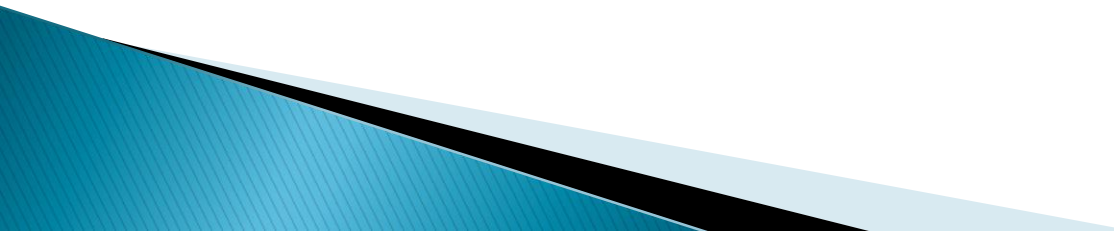




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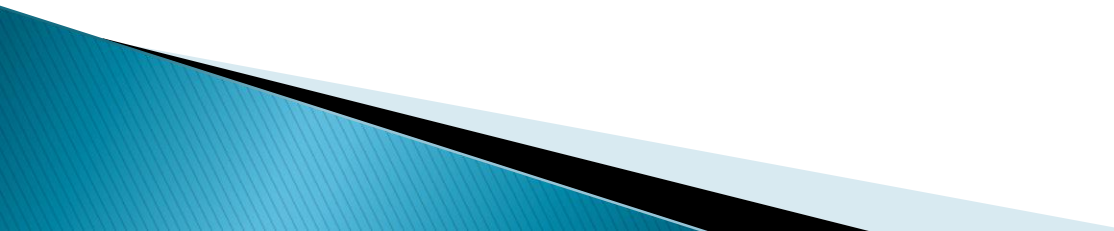
- ▶ The molecular structure of the plasma membrane. Note the one-pass and multipass transmembrane proteins. A peripheral protein is in the external face of the membrane, but the proteins are present mainly in the cytoplasmic face. (from Junqueira, Carneiro: *Biologia Celular e Molecular*, 6th ed. Editora Guanabara, 1997.)

# Fundamental tissues

- ▶ Epithelial Tissue
  - ▶ Connective Tissue
  - ▶ Muscular Tissue
  - ▶ Nervous Tissue
- 



# Four Fundamental Tissues

- ▶ **Epithelial T.** – cover body & organ surfaces, line body & cavities, and form glands.
  - ▶ **Connective T.** – bind, support and protect body parts.
  - ▶ **Muscle T.** – contract to produce movement
  - ▶ **Nervous T.** – initiate & transmit nerve impulses from one body part to another.
- 

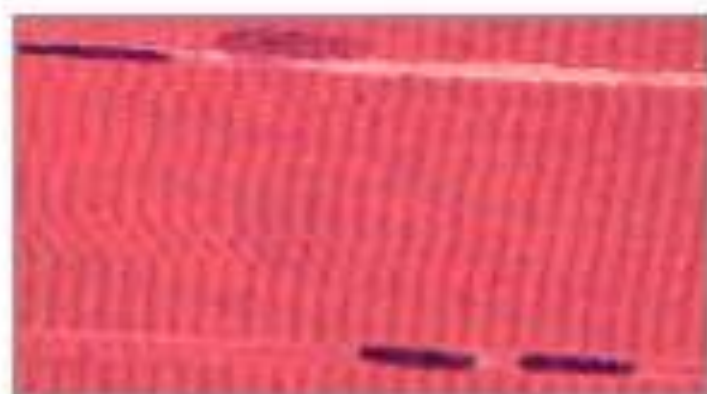
## Four types of tissue



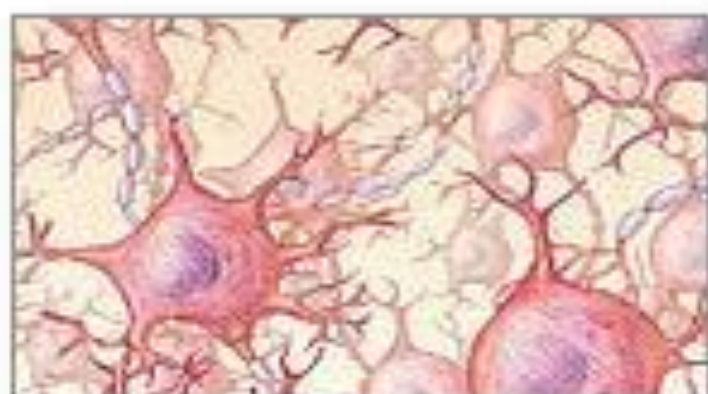
Connective tissue



Epithelial tissue

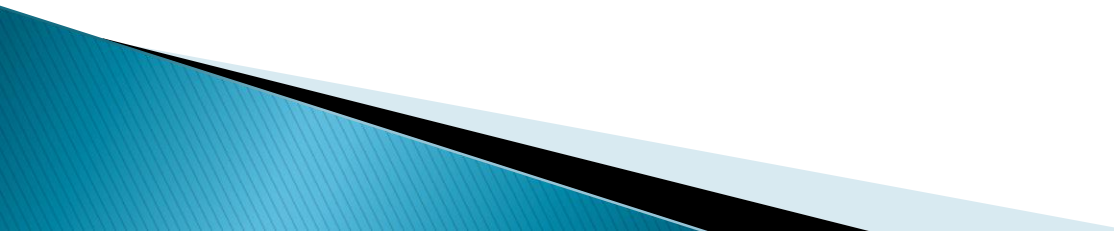


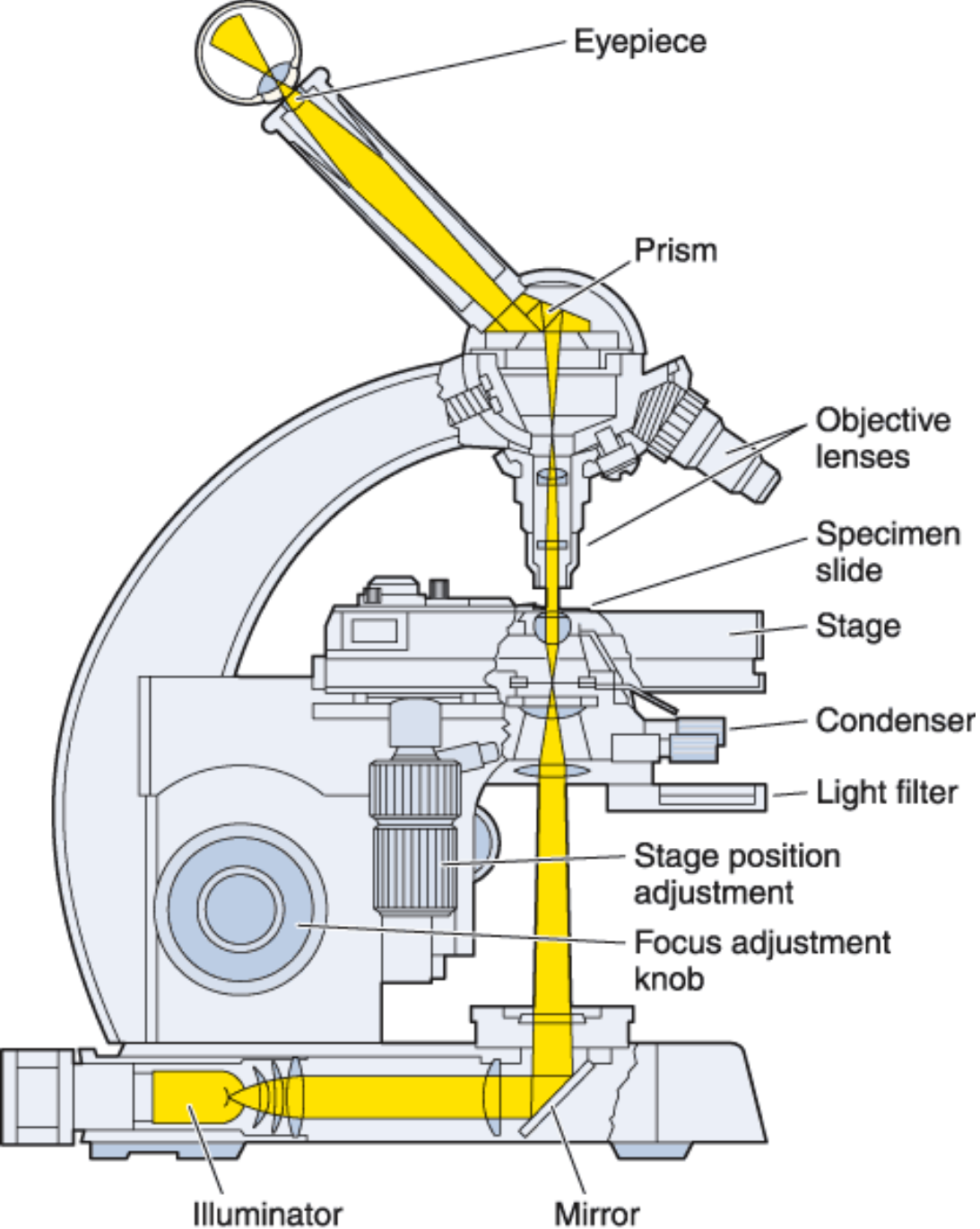
Muscle tissue



Nervous tissue

# Understanding fundamental tissues

- ▶ Each of the fundamental tissues is formed by several types of cells and by specific associations of cells and ECM. These distinct associations facilitate the recognition of the many subtypes of tissues by students.
  - ▶ Organs are formed by an orderly combination of several tissues, except CNS, which is formed almost solely by nervous tissue.
  - ▶ Combination of tissues allow proper functioning carried out by each organ affecting the organism as a whole.
  - ▶ Histology or Tissue biology – the study of small cells and matrix components makes histology dependent on the use of microscopes.
- 

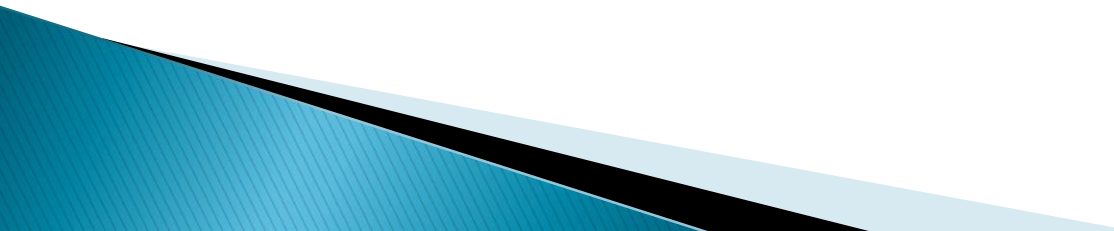


Calibration factors:


- ▶ Scanner =  $125\mu\text{m}$
- ▶ LPO =  $50\mu\text{m}$
- ▶ HPO =  $12.5\mu\text{m}$
- ▶ OIO =  $5\mu\text{m}$

Size of object = no.  
ocular units X  
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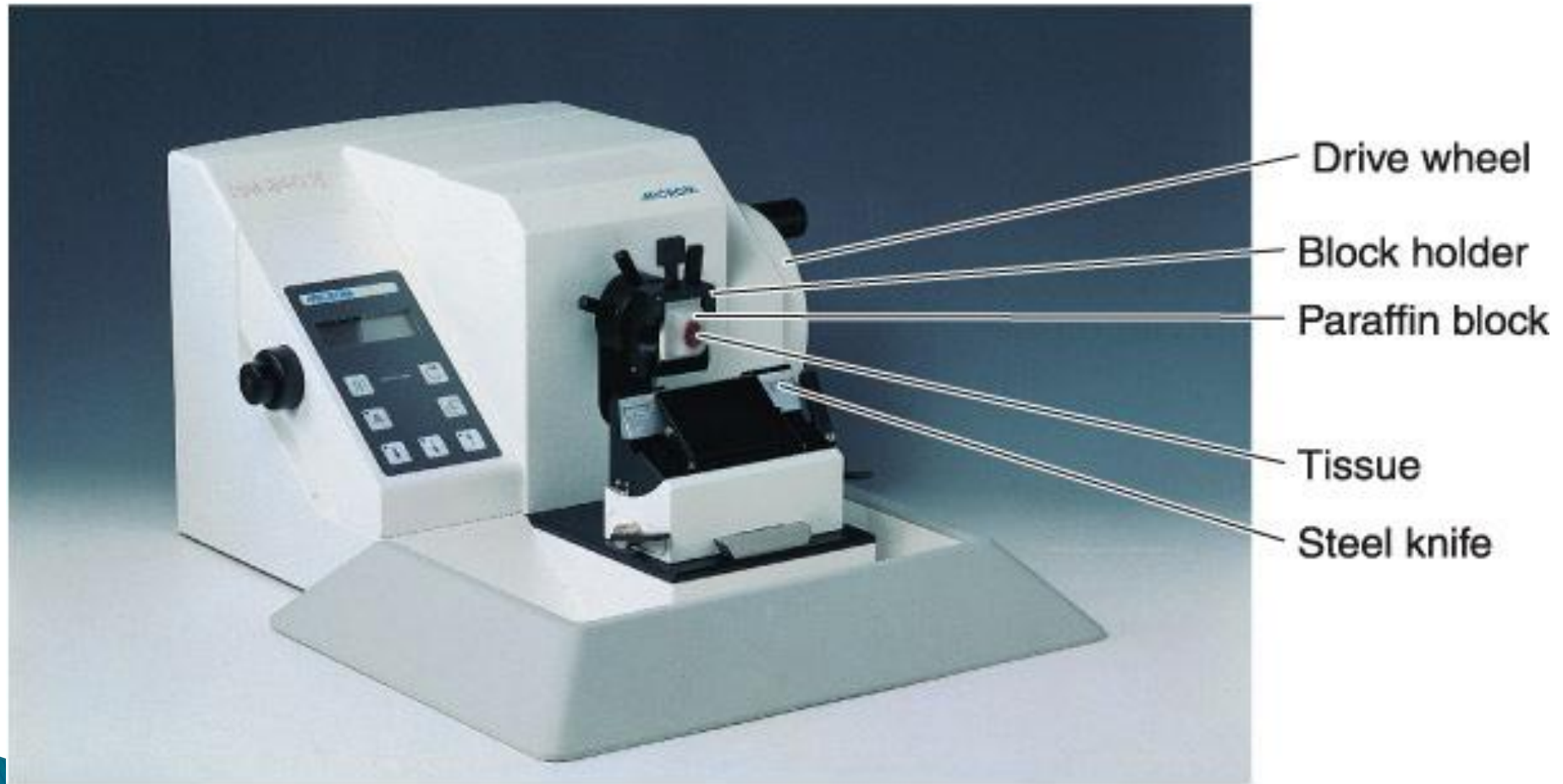
# Histological Anatomy

- ▶ Advances in chemistry, physiology, immunology, and pathology—and the interactions among these fields—are essential for a better knowledge of tissue biology.
  - ▶ Familiarity with the tools and methods is essential for a proper understanding of the subject.
- 

# Microsectioning

- ▶ The preparation of tissues for microscopic examination
  - ▶ Tissues and organs are usually too thick for light to pass through them, they must be sectioned to obtain thin, translucent sections. However, living cells, very thin layers of tissues, or transparent membranes of living animals (Ex: mesentery, tadpole tail, the wall of cheek) can be observed directly in the microscope without microsectioning.
  - ▶ Most tissues need thin slices using microtome.
  - ▶ This method preserves tissues in longer duration under varying physiological or experimental conditions.
- 

# Microtome



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# Tissue preparation

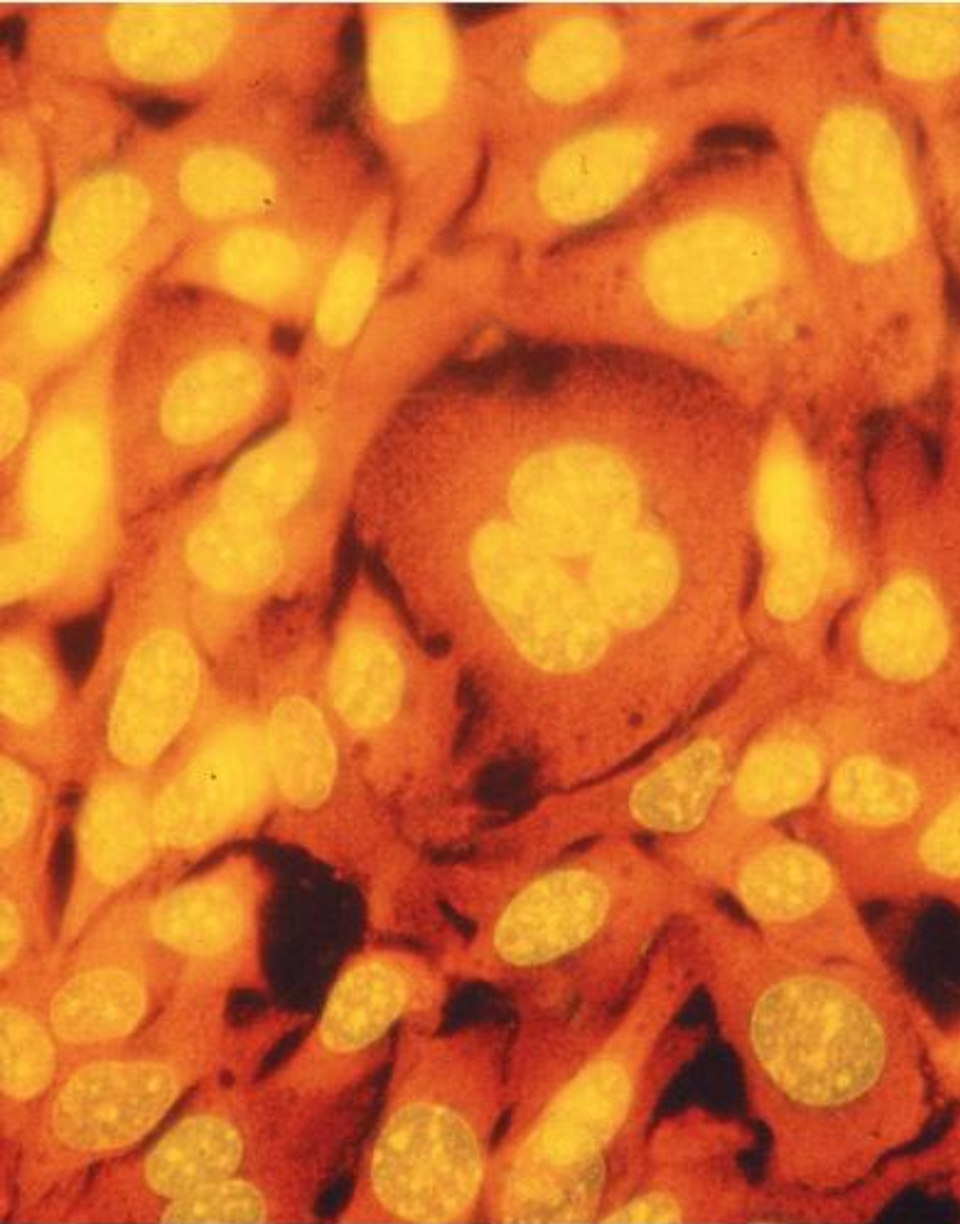
- ▶ **Fixation** – prevents autolysis (self-destruction) or bacterial invasion of tissues leading to tissue distortion and degradation
  - Use of fixative chemicals as stabilizers or cross-linkers maintaining the molecular and structural composition of tissues. (Formaldehyde and glutaraldehyde are widely used fixatives which react with the amine groups (NH<sub>2</sub>) of tissue proteins. Glutaraldehyde, fixing action is reinforced since it is a dialdehyde, can cross-link proteins. )



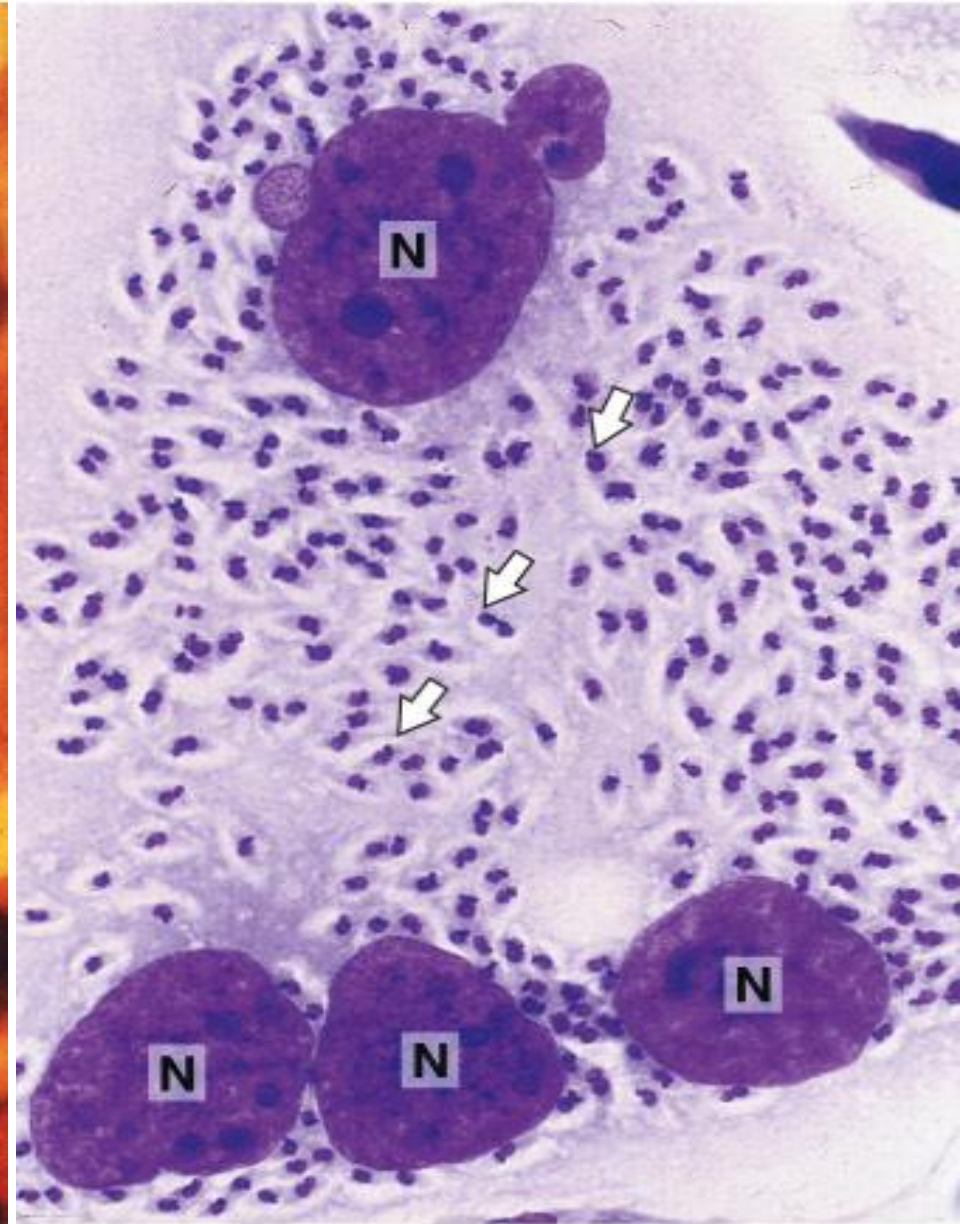
- ▶ **Embedding or tissue impregnation** – use of solid medium to facilitate sectioning. Paraffin or plastic resins give a rigid consistency to the tissue. Involves dehydration (ethanol) and clearing (xylene), and paraffin impregnation. – Tissue block
- ▶ **Tissue sectioning** – mounting the tissue block in the microtome
- ▶ **Staining** – use of dyes to penetrate into translucent tissue section. Basic and acidic dyes impart contrast to microsectioned tissues allowing the observer to study the cells and its ultrastructures and the matrix.

# Behavior of tissues to dyes

- ▶ **Hematoxylin and Eosin (H&E)** – commonly used dyes
- ▶ **Basic dyes** – hematoxylin, toluidine blue, methylene blue stain *basophilic* structures such as nucleus, free ribosomes, matrix of hyaline cartilage.
- ▶ **Acid dyes** – orange G, eosin, acid fuchsin stain the *acidophilic* components of tissues such as mitochondria, secretory granules, cytoplasm and collagen.
- ▶ **Trichromes** – differentiating stains
- ▶ **Counterstain** – a single stain that is applied to a section to allow the recognition of nuclei or cytoplasm, is used.
- ▶ **Metallic dyes** – silver or gold is ideal for nervous tissue.

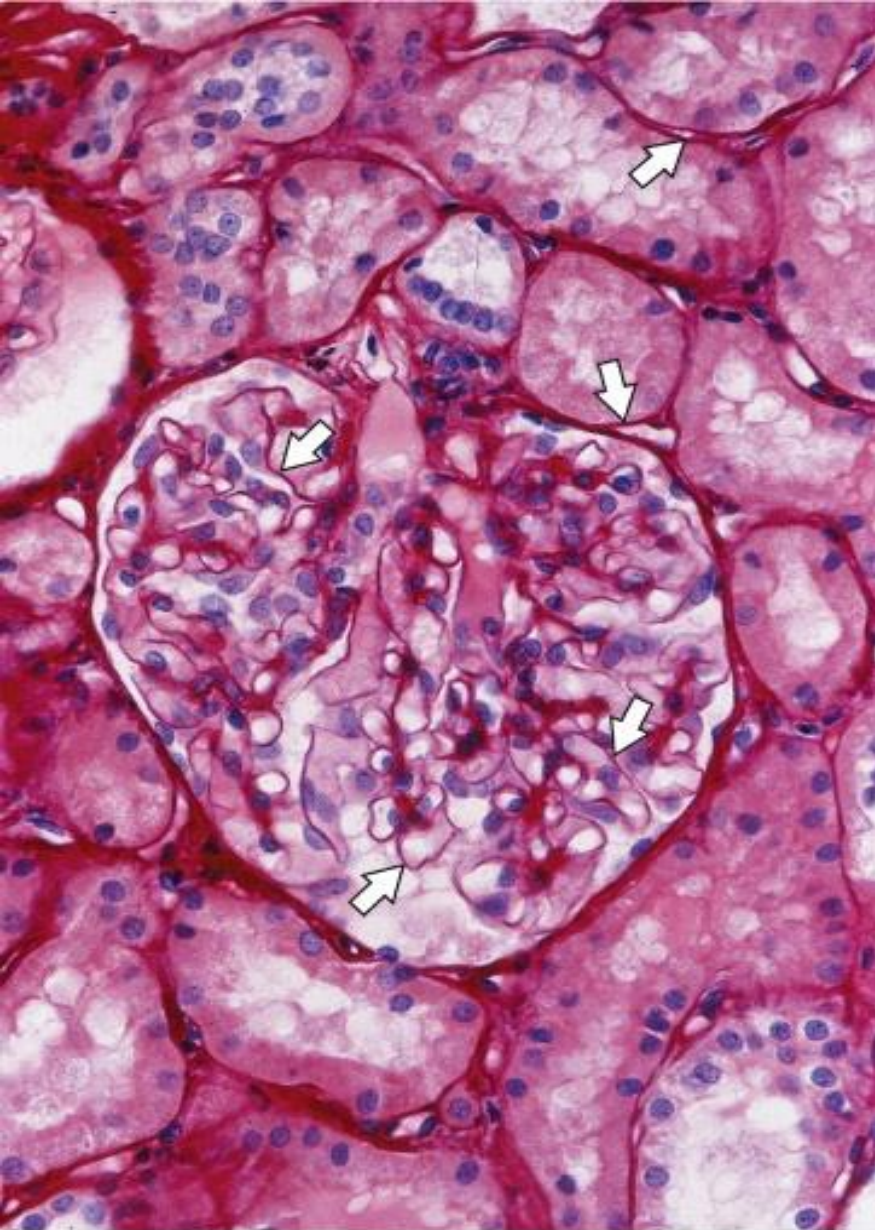


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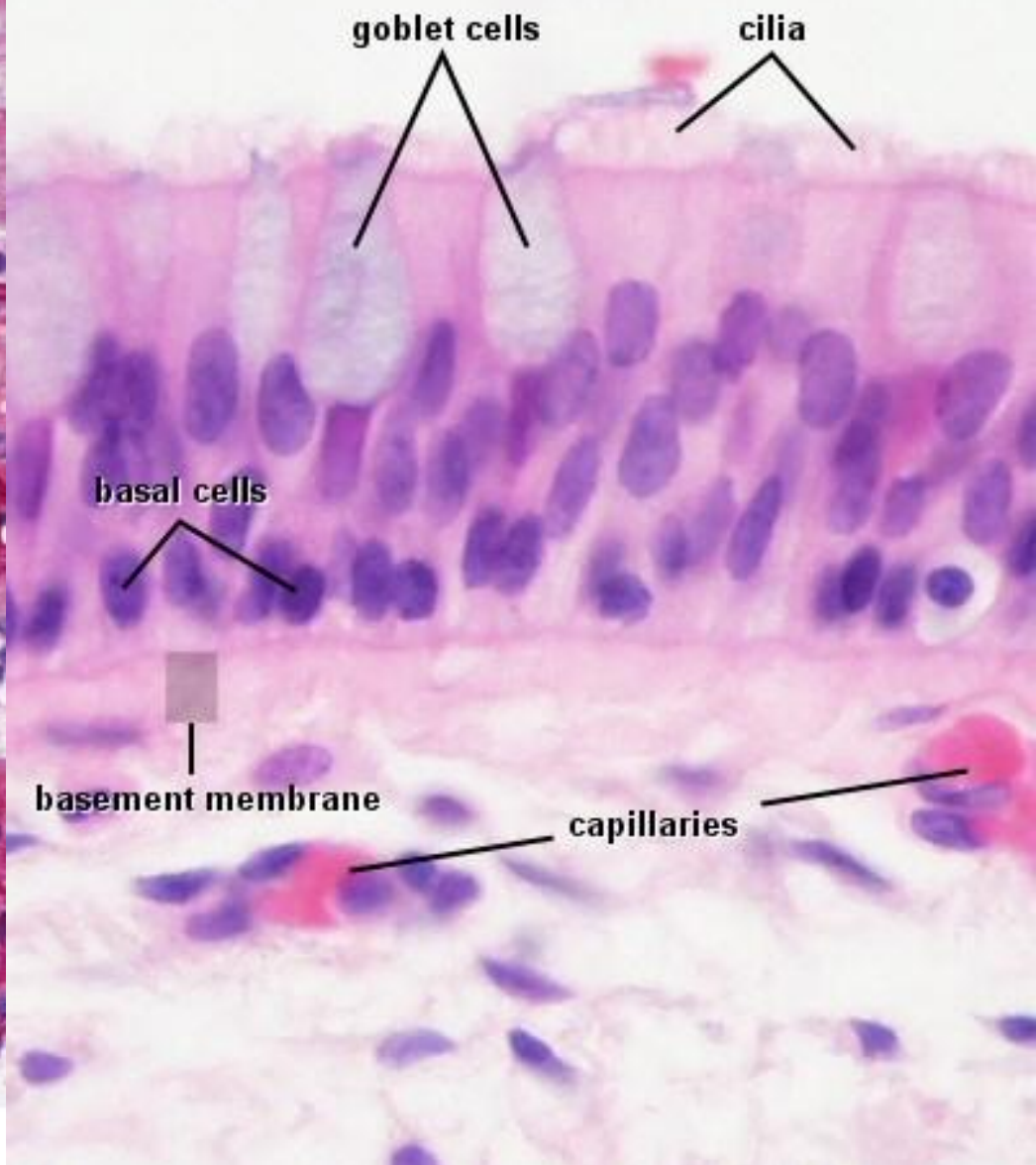
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L-Fluorescent micrograph of rat kidney cells showing eosinophilic reaction. R- Chicken fibroblast with blood parasite *T. cruzi* infection.

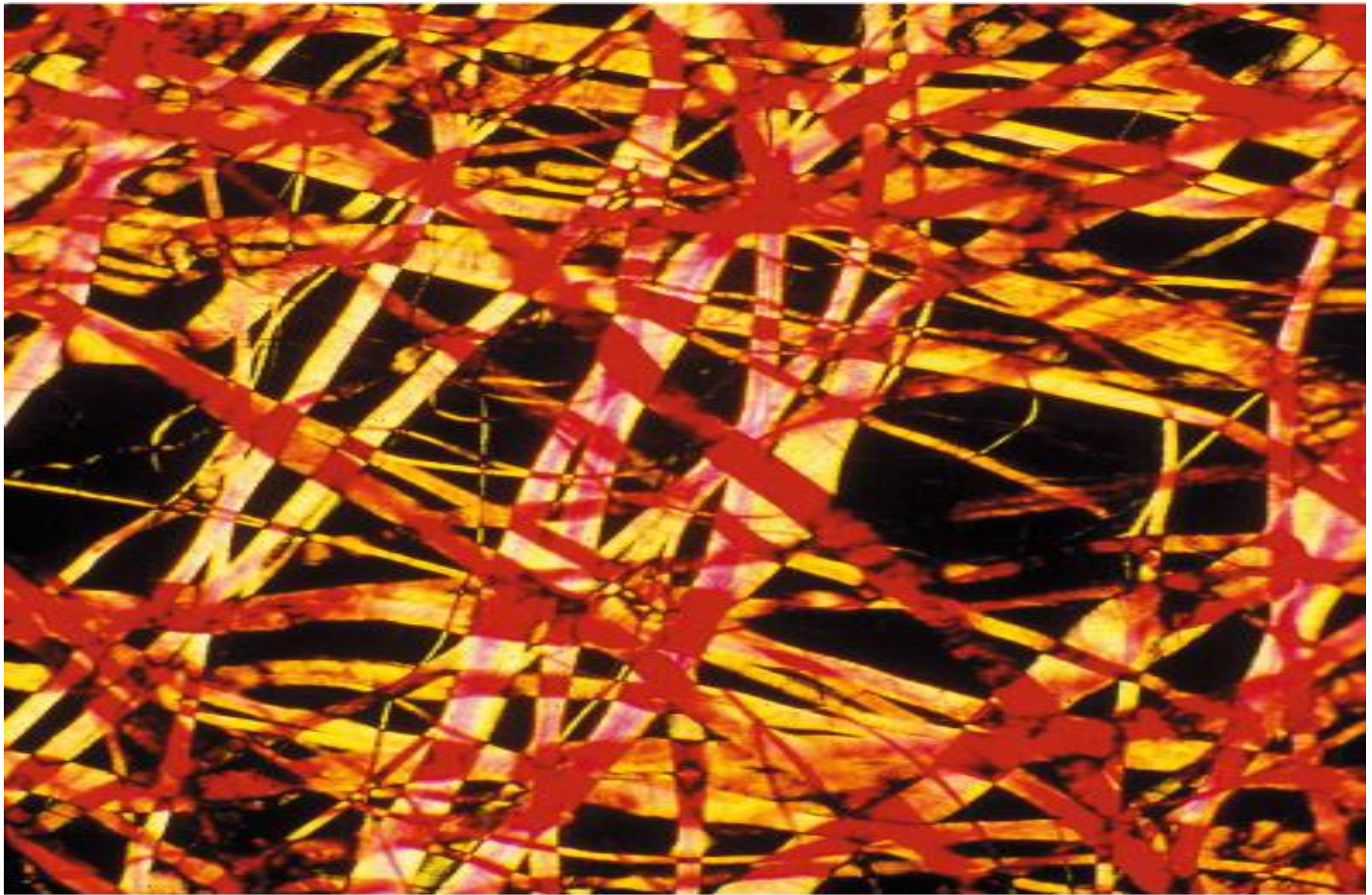


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Trachea H&E

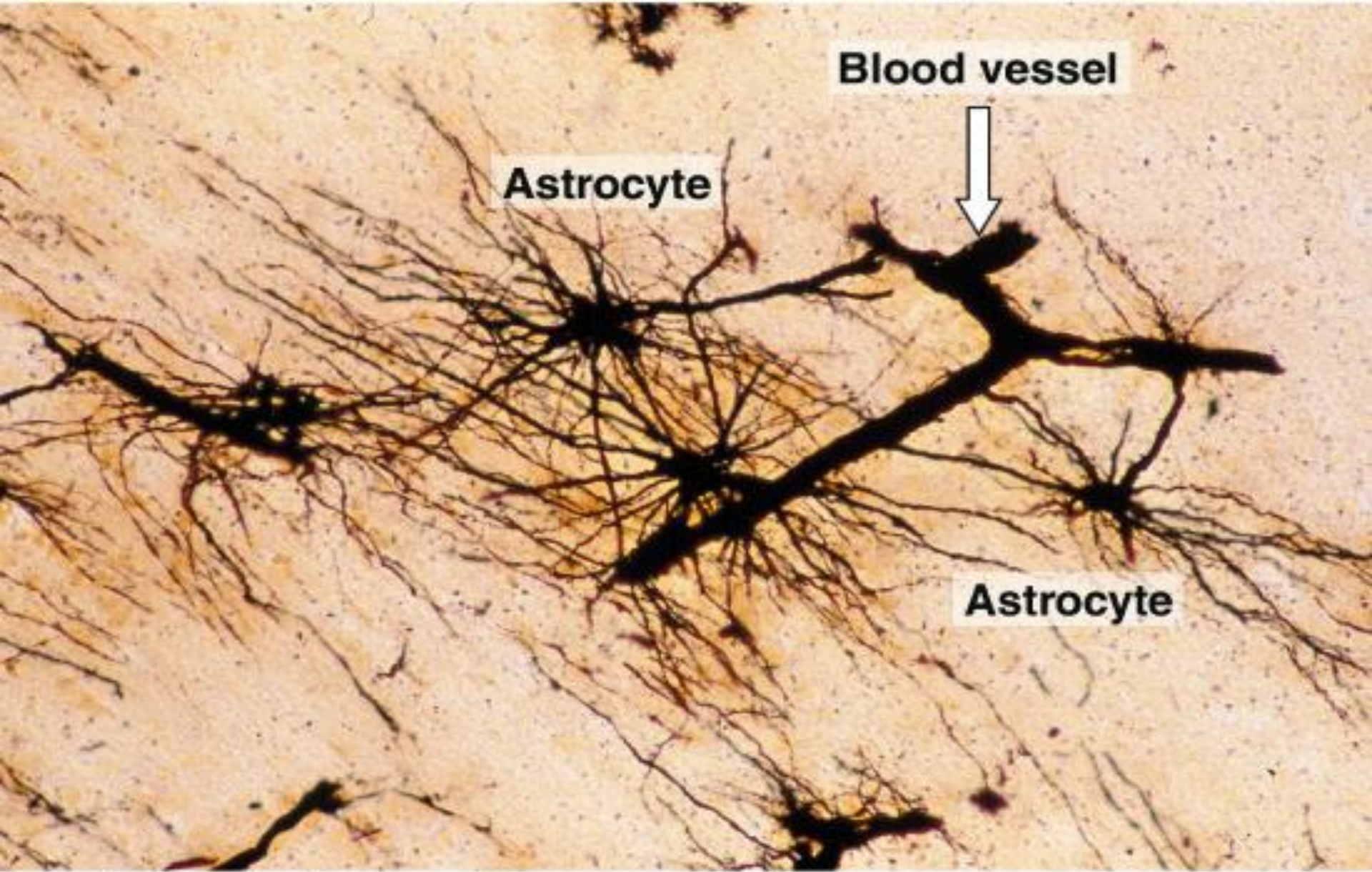


Combination dyes – L: picosirius and hematoxylin in rat kidney glomerulus and tubules. R: human trachea in H&E.



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- ▶ Trichrome stain using picrosirius to show the collagen fibers in the rat mesentery.

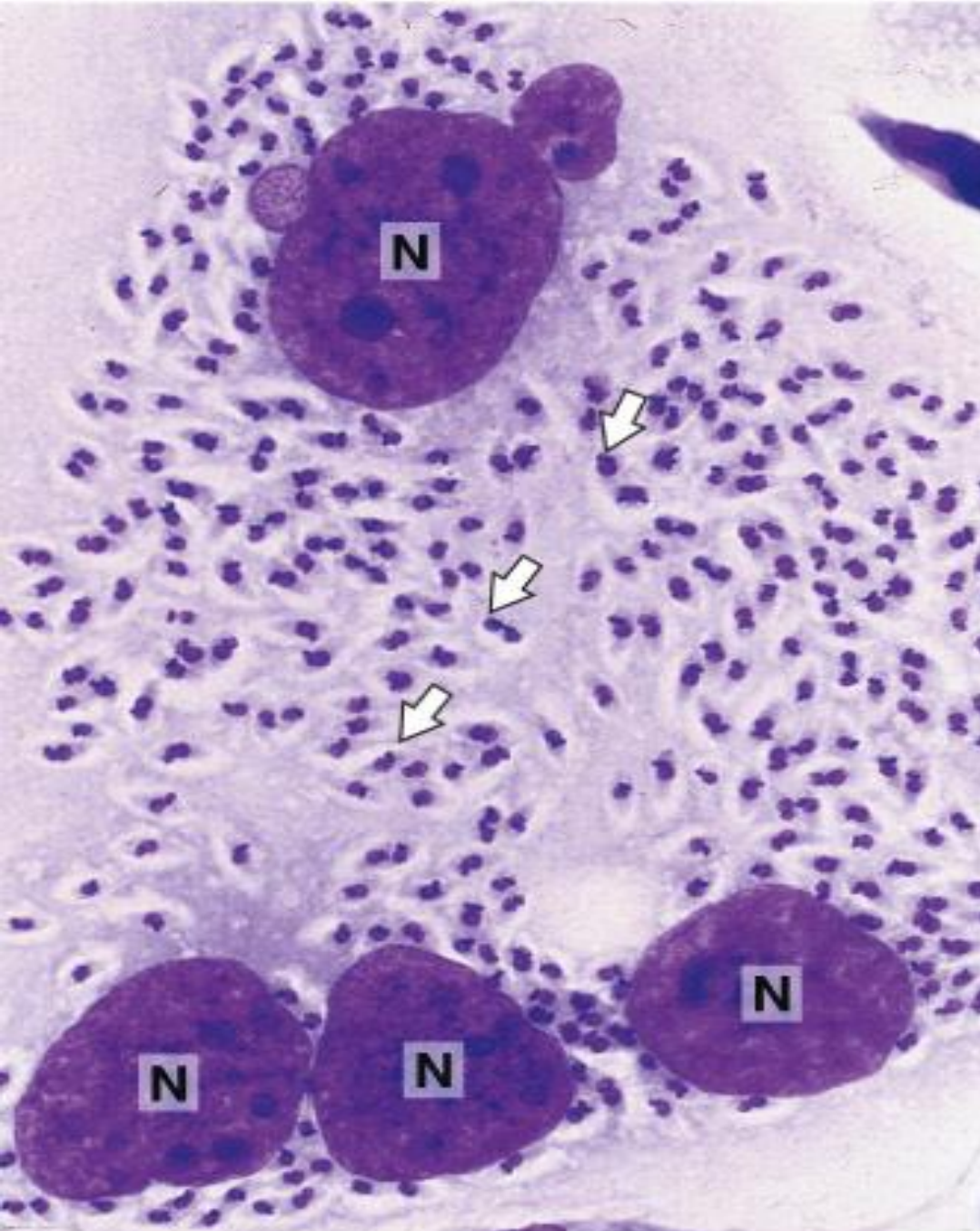


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▶ Metallic dyes - Silver stain in nervous tissue

# Cell culture

- ▶ Culturing cells outside the host's body.
- ▶ Several experiments that cannot be performed in the living animal can be reproduced *in vitro*.
- ▶ Laboratory-grown cells are supported with a media simulating its natural known components (salts, amino acids, vitamins) that are frequently added.
- ▶ Once isolated, the cells are cultivated in a suspension or spread out on a Petri dish or glass slide, to which they adhere, usually as a single layer of cells (embryonic tissues). Isolated cultures of cells are called **primary cell cultures**.
- ▶ It has been widely used for the study of the metabolism of normal and cancerous cells and for the development of new drugs and studying intracellular parasites and bacteria.
- ▶ Cultured cells: HeLa cells (breast CA cells) and Vero cells (kidney)



- ▶ Chicken Fibroblastic cells grown in cell culture infected with *Trypanosoma cruzi*, a blood parasite (arrows).



***Thank you for listening!***

