Republic of Iraq
Ministry of Higher Education
and Scientific Research
The Islamic University college
AL-Najaf Al-Ashraf
College of Dentistry

INTRODUCTION TO HISTOLOGY

By
T.A. Hawra'a F. AL.Baghdady

Introduction to Histology

T.A Hawra'a F. AL.Baghdady

Histology is the study of the tissues of the body and how these tissues are arranged to constitute organs. The Greek root *histo* can be translated as either "tissue" or "web" and both translations are appropriate because most tissues are webs of interwoven filaments and fibers, both cellular and noncellular, with membranous linings. Histology involves all aspects of tissue biology, with the focus on how cells' structure and arrangement optimize functions specific to each organ.

Tissues are made of two interacting components: cells and extracellular matrix. The main functions once attributed to the extracellular matrix were to furnish mechanical support for the cells, to transport nutrients to the cells, and to carry away catabolizes and secretory products the cells produce the extracellular matrix, they are also influenced and sometimes controlled by molecules of the matrix. There is, thus, an intense interaction between cells and matrix, with many components of the matrix recognized by and attaching to receptors present on cell surfaces Thus, cells and extracellular matrix form a continuum that functions together and reacts to stimuli and inhibitors together Each of the fundamental tissues is formed by several types of cells and typically by specific associations of cells and extracellular matrix. These characteristic associations facilitate the recognition of the many subtypes of tissues The small size of cells and matrix components makes histology dependent on the use of microscopes

MICROSCOPY

1- LIGHT MICROSCOPY

Conventional bright-field microscopy, as well as fluorescence, phase-contrast, differential interference, confocal, and polarizing microscopy are all based on the interaction of light and tissue components and can be used to reveal and study tissue features.

2- Bright-Field Microscopy

With the bright-field microscope, widely used by students of histology, stained preparations are examined by means of ordinary light that passes through the specimen. The microscope is composed of mechanical and optical parts. The optical components consist of three systems of lenses. The condenser collects and focuses light, producing a cone of light that illuminates the object to be observed. The objective lenses enlarge and project the illuminated image of the object in the direction of the eyepiece. The eyepiece or ocular lens further magnifies this image and projects it onto the viewer's retina, photographic film, or
(to obtain a digital image) a detector such as a charge-coupled device (CCD) camera. The total magnification is obtained by multiplying the magnifying power of the objective and ocular lenses

3- ELECTRON MICROSCOPY

Transmission and scanning electron microscopes are based on the interaction of electrons and tissue components. The wavelength in the electron beam is much shorter than of light, allowing a thousand-fold increase in resolution.

4- Transmission Electron Microscopy

The transmission electron microscope (TEM) is an imaging system that permits resolution around 3 mm (Figure 1–8a). This high resolution allows magnifications of up to 400,000 times to be viewed with details. Unfortunately, this level of magnification applies only to isolated molecules or particles. Very thin tissue sections can be observed with details at magnifications of up to about 120,000 times.

5- Scanning Electron Microscopy

Scanning electron microscopy (SEM) permits pseudo–three-dimensional views of the surfaces of cells, tissues, and organs. Like the TEM this microscope produces and focuses a very narrow beam of electrons, but in this instrument the beam does not pass through the specimen (Figure 1-8b). Instead the surface of the specimen is first dried and coated with a very thin layer of metal atoms through which electrons do not pass readily. When the beam is scanned from point to point across the specimen it interacts with the metal atoms and produces reflected electrons or secondary electrons emitted from the metal. These are captured by a detector and the resulting signal is processed to produce a black-and-white image on a monitor. SEM images are usually easily understood, because they present a view that appears to be illuminated from above, just as our ordinary macroscopic world is filled with highlights and shadows caused by illumination from above.

Tissues Preparation

The most common procedure used in the study of tissues is the preparation of histological sections or tissue slices that can be studied with the aid of the light microscope. Under the light microscope, tissues are examined via a light beam that is transmitted through the tissue. Because tissues and organs are usually too thick for light to pass through them, they must be sectioned to obtain thin, translucent sections and then attached to glass slides before they can be examined. The ideal microscope tissue preparation should be preserved so that the tissue on the slide has the same structure and molecular composition as it had in the body. However, as a practical matter this is seldom feasible and artifacts, distortions, and loss of components due to the preparation process are almost always present
This is a multi-step process that includes

1- Fixation (preserves the tissue)

2- **Embedment (stabilizes the tissue for sectioning)**
3- **Sectioning (cuts the specimen into thin slices of about 5 um)**
4- **Placing the sections on a glass slide so they can be stained for viewing.**

A note about resolution and detection. Resolution refers to the ability to discriminate between two adjacent objects. For the light microscope with optimal lenses and sample preparation this Approaches 0.2um, which is the theoretical limit for light microscopes. [The eye can resolve about 250-500 um and the electron microscope can resolve about 1 nm).
Detection refers to the ability to detect something and this can be much smaller than the limit of resolution. For fluorescence molecules this can be as little as a few molecules. There are several challenges in learning histology The first being that the view observed through a microscope gives you a perspective that you are unlikely to have experienced previously. It is a complex data set one with a broad range of shapes and sizes with varying shades of red and blue. This complex image offers very few clues that are intuitive. Also, the tissue specimen is a two dimensional slice of a complex three dimensional structure. So, once the two dimensional image has been ascertained you still have the challenge of imagining its three dimensional elaboration.

Biological Stains

Biological Stains are dyes which are frequently used in biology and medicine to highlight structures in biological tissues. These biological stains are also used in the identification and study of polymer structures. There are three broad categories of biological stains:

- **General or Routine Stains: Used to differentiate between the nucleus and the cytoplasm. This allows for the different tissue types to be distinguished from one another. These stains use one, two, or sometimes three dyes. The H&E stain falls into this category.**

- **Special Stains: These are used to demonstrate specific elements within the tissue, such as connective tissue, muscle, carbohydrates, lipids, pigments, and nerve tissue.**

- **Heavy Metal Impregnation: Involves the deposit of metallic substances onto targeted cells. This is often used to**