



# HISTOLOGY



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## GLANDULAR EPITHELIA

These are complex formations associated with: connective tissue, blood vessels, or nerves.

Their cells elaborate one or more specific products for the use of other tissues of the organism.

Glands are controlled by several factors: hormonal, nervous, cholinergic, local (blood flow), calcium permeability, psychological, and mechanical factors.

The following types can be distinguished:

- **Exocrine glands:** secrete their product toward the external environment (generally possess an excretory duct). Ex: sweat gland.
- **Endocrine glands:** the product (signaling factor = hormones, growth factors, peptides...) is released directly into the blood or lymph, i.e., no excretory duct. Ex: thyroid.
- **Amphicrine glands:** both exocrine and endocrine simultaneously. Ex: Pancreas, liver, ovary, testis.

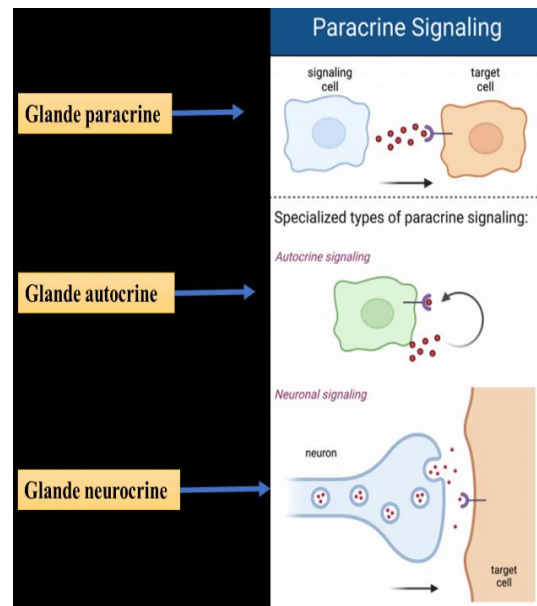
There are **3 modes of glandular signaling**:

**Paracrine gland:** secretes the product intended for neighboring target cells.

**Autocrine gland:** its product acts directly on itself.

**Neurocrine gland:** each cell possesses an extension that makes contact with a target cell. The secretion of the product (neurohormones) occurs at the tip of the extension (directed secretion) and is controlled by the central nervous system.

**Figure 1**



### Embryological Origin of Glands

Glandular epithelia form by invagination of an embryonic epithelium (3 germ layers) during development. They can give rise to either an endocrine gland or an exocrine gland.

| ORIGIN \ TYPE    | Exocrine Glands  | Endocrine Glands  |
|------------------|--|---|
| <b>Ectoblast</b> | • Cutaneous glands (sebaceous, sudoriferous) • Mammary glands • Parotid glands | • Adrenal medulla • Neurohypophysis                                       |
| <b>Mesoblast</b> | • Accessory genital glands   | • Adrenal cortex • Interstitial glands of the gonads                      |
| <b>Endoblast</b> | • Liver • Salivary glands  | • Thyroid and parathyroids • Liver • Islets of Langerhans of the pancreas |

### I. EXOCRINE GLANDS

They are in relation with:

- the surface of the organism (epidermis) via the excretory duct.
- the lumen of a hollow organ (intestine).

The excretory duct allows the passage of the glandular secretion, which is elaborated at the level of the secretory unit.

**Goblet cells:** elaborate mucus and have no excretory duct.

| ORIGINE \ TYPE    | Glandes exocrines  | Glandes endocrines   |
|-------------------|--|--|
| <b>Ectoblaste</b> | • Glandes cutanées (sébacées, sudoripares)<br>• Glandes mammaires<br>• Parotides | • Médullo-surrénale<br>• Neuro-Hypophyse                                   |
| <b>Mésoblaste</b> | • Glandes génitales accessoires  | • Corticosurrénale<br>• Glandes interstitielles des gonades génitales      |
| <b>Endoblaste</b> | • Foie<br>• Glandes salivaires   | • Thyroïde et parathyroïdes<br>• Foie<br>• Ilots de Langerhans du pancréas |

Figure 2

### Goblet Cells

There are 2 types:

- **Open goblet cell (open mucous goblet cell):** they have an open apical plasma membrane and are generally isolated. Ex: in the intestinal/respiratory lining epithelium.
- **Closed goblet cell (closed mucous goblet cell):** they have a closed apical plasma membrane.

**Role:** protection of cells against enzymes and acids; they are generally grouped. Ex: in the gastric lining epithelium.

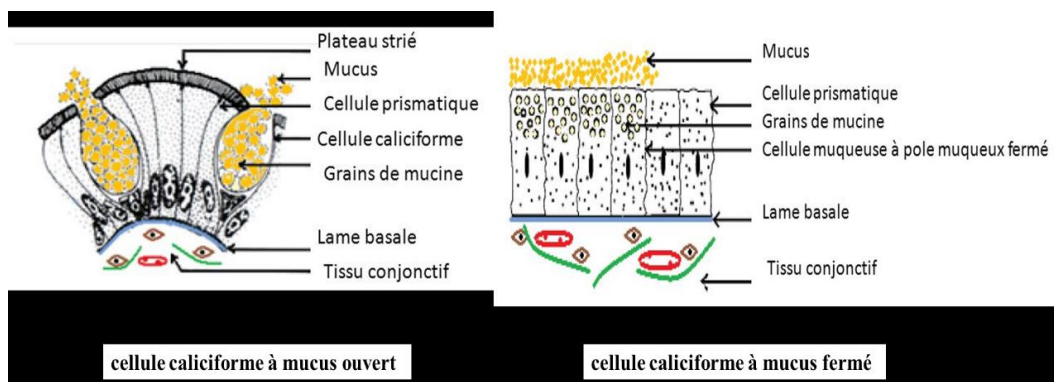


Figure 3

### Classification of Exocrine Glands

According to their morphology:

- according to the number of cellular elements
- according to the shape of the secretory units and ducts
- nature of the secreted product
- mode of excretion

#### 1/ According to the Number of Cellular Elements

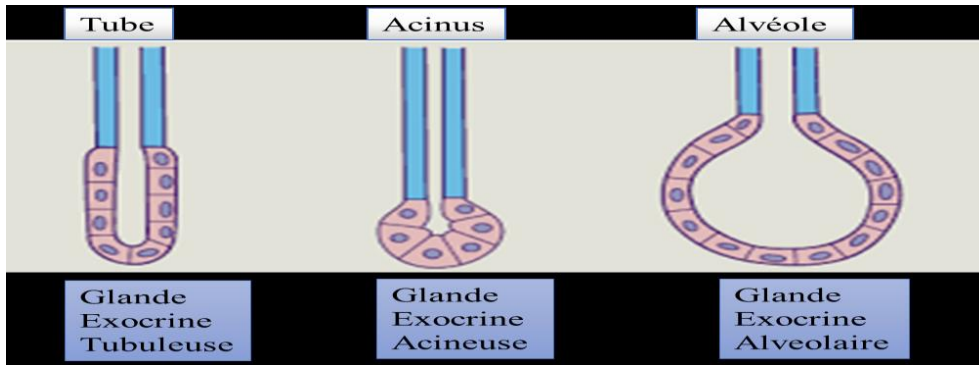
- **Unicellular exocrine gland:** anchored in the lining epithelia, represented by open mucous goblet cells. Ex: respiratory lining epithelium (LE) such as the trachea, or intestinal lining epithelium.
- **Pluricellular exocrine gland** – 2 types: – Surface type: closed mucous goblet cells (gastric LE) – Embedded deep in connective tissue: (the majority of exocrine glands); they consist of a secretory unit + excretory duct(s).

#### 2/ According to the Shape of the Secretory Units and Ducts

For glands embedded deep in the connective tissue:

**A/ The Secretory Unit**

It can be:

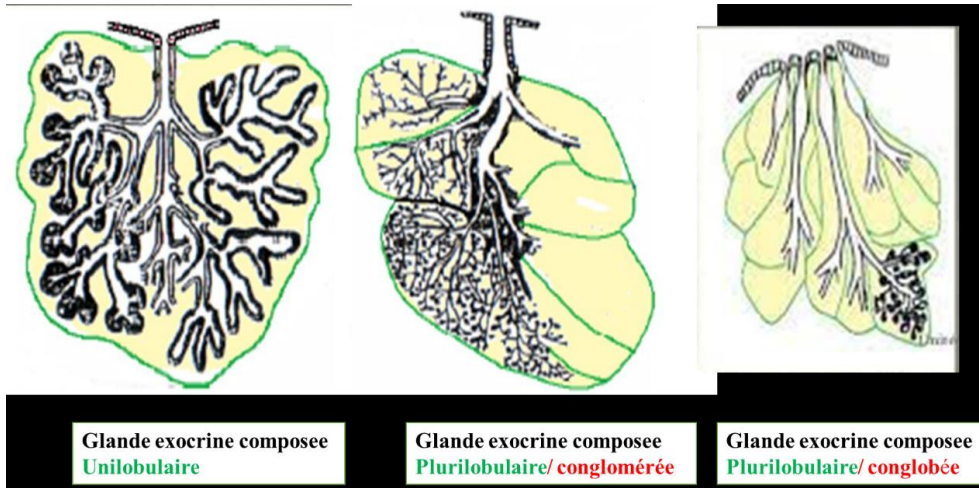


**Figure 4**

The tube can be either straight or coiled.

– A compound form may exist: tubulo-alveolar / tubulo-acinar.

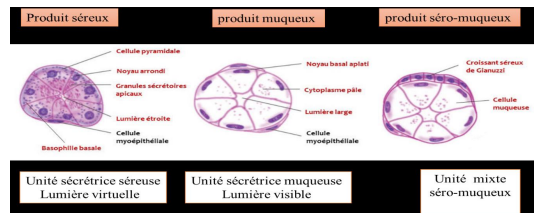
**B/ The Excretory Duct**



**Figure 5**

– The secretory units of compound glands all have the same shape (tube, acinus, etc.).

The branched tubular exocrine gland is simple, not compound (the branching is at the level of the secretory unit). Ex: sweat gland.



**Some glands may present lobules**

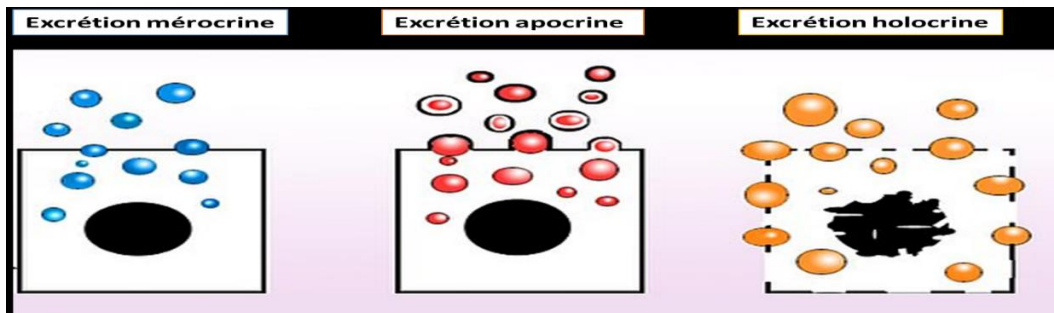


Figure 6

- **Conglomerate:** a single common terminal duct for all lobules.
- **Conglobate:** each lobule has its own terminal duct.

**ANATOMICAL GLAND:**  
 It is a gland resembling an organ: compound, with a single terminal duct, generally encapsulated and grouped into clusters. Ex: mammary gland.  
 - If not, it is called a **Non-anatomical gland.**

**3 – Nature of the Secreted Product**

- The products elaborated by exocrine glandular cells are varied: mucous product, serous product, saliva, sweat, tears, milk, etc.
- Only serous and mucous products are included in the classification.

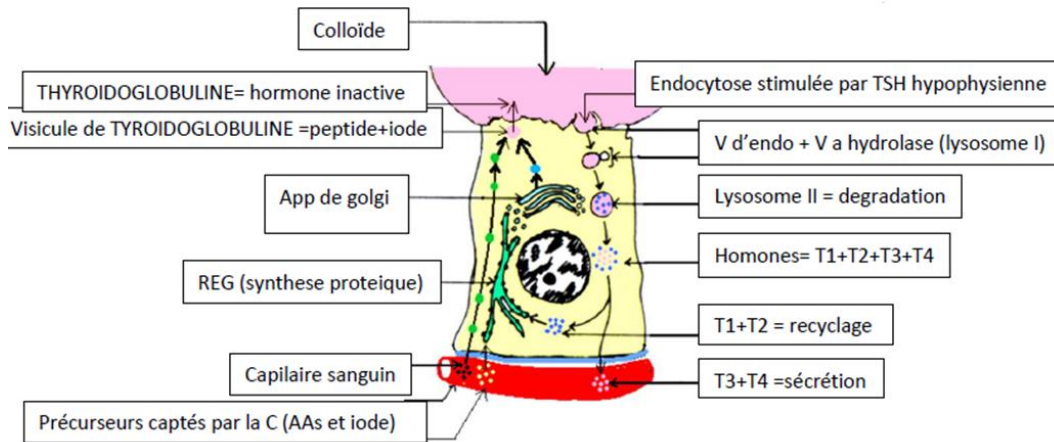


Figure 7

The size of a serous gland (ex: parotid) is smaller than a mucous gland (ex: Brunner's). Example of a mixed seromucous gland: submandibular gland.

#### 4 – Mode of Excretion

**Merocrine secretion:** elimination of the product by diffusion or exocytosis. Ex: parotid.

**Apocrine secretion:** elimination of the product along with a portion of the apical cytoplasm that detaches. The cell subsequently renews its lost organelles and restores its continuity.

**Holocrine secretion:** elimination of the product together with the entire cell. Ex: sebaceous gland.

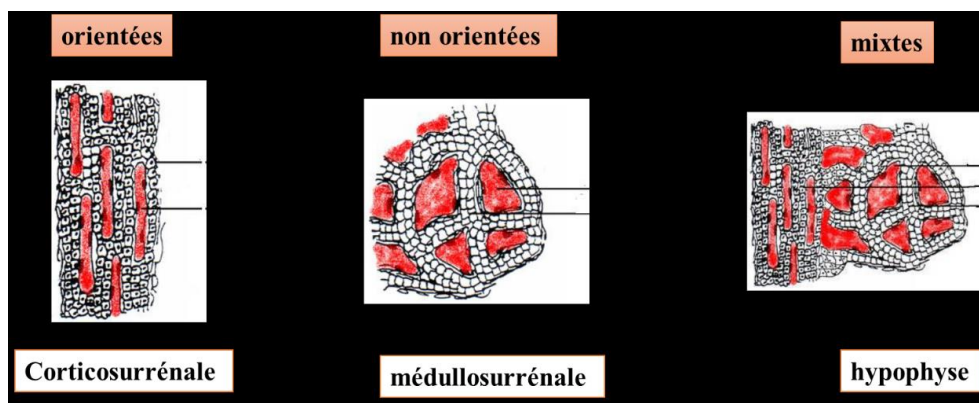


Figure 8

## II. ENDOCRINE GLANDS

- They are generally anatomical glands always located in contact with a blood capillary.
- They release their secretory product (hormone) in very small quantities directly into the blood or lymph (no excretory duct).

- Role: specific regulation of the functioning of organs distant from the site of synthesis.

-6-

-9-

## MORPHOLOGICAL CLASSIFICATION OF ENDOCRINE GLANDS

- **Unicellular endocrine gland:** only the C cells of the thyroid.
- **Pluricellular endocrine gland:** divided into 3 types:
  - vesicular
  - diffuse
  - tabular

### A/ Vesicular

- The thyroid is an assembly of vesicles formed by the principal thyroid cells = vesicular endocrine gland.
- This morphology allows the storage of inactive products (thyroid hormones) in the colloid lumen.

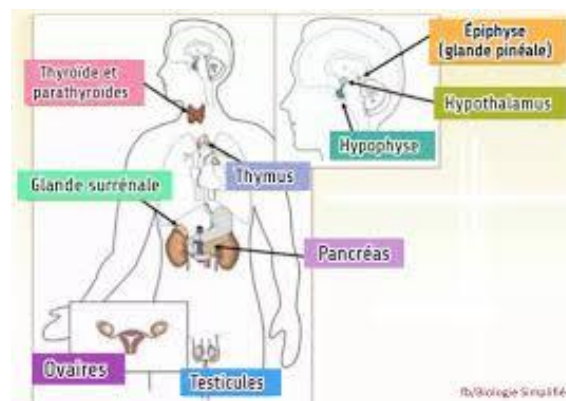


Figure 9

### Functioning of the Thyroid Cell

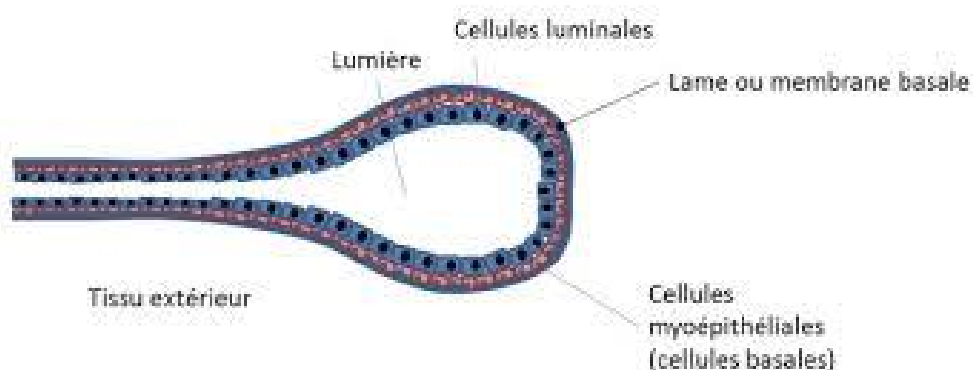


Figure 10

### B/ Diffuse

Cells are isolated or grouped in clusters within the connective tissue. Example: testicular interstitial glands = assembly of Leydig cells + a blood vessel. (Leydig cell ≠ Gland)

### C/ Tabular

Tabular [or cordonal]: formed by cellular trabeculae (cords); either:

- **Oriented (or fasciculated):** rectilinear, as in the adrenal cortex (elaborates corticoids such as cortisol).
- **Non-oriented (or reticular):** multidirectional, as in the adrenal medulla (produces adrenaline) and the parathyroids (4 glands behind the thyroid).
- **Mixed:** as in the pituitary gland (hypophysis).

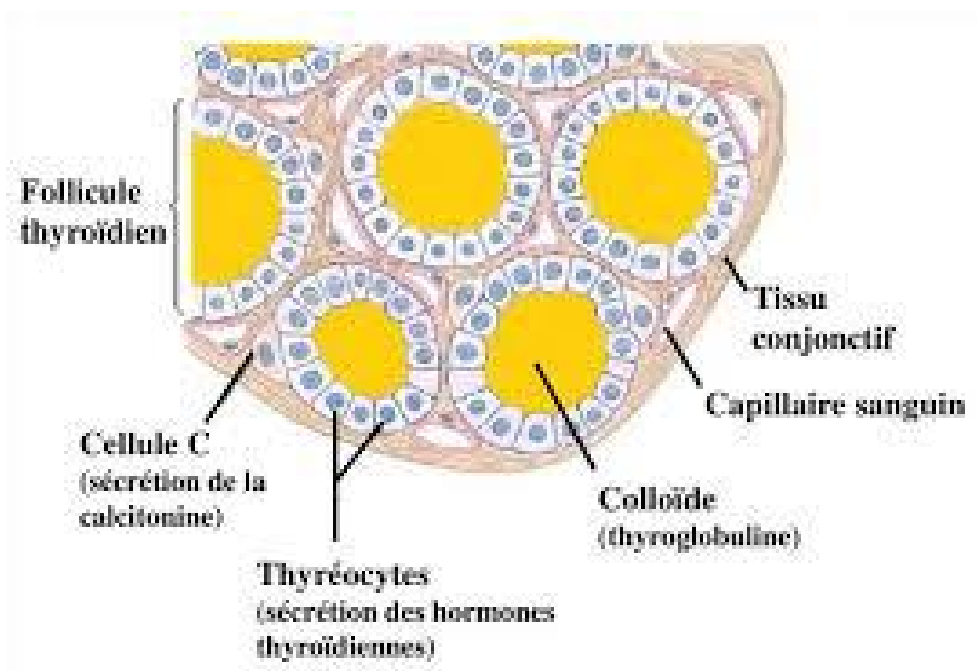


Figure 11

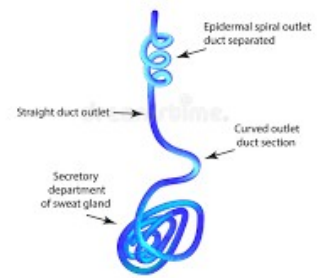
## Main Endocrine Glands of the Human Body

– **The hypothalamus:** located at the base of the brain, connected to the pituitary by the pituitary stalk. It links the nervous system and the endocrine system. Role: regulate pituitary activity via GnRH and GnIH released into the blood.

– **The pituitary gland (hypophysis):** placed in a bony fossa at the base of the skull; comprises 3 parts: the adenohypophysis, the neurohypophysis, and the intermediate lobe.

– **The pineal gland (epiphysis):** elaborates melatonin for sleep regulation; exerts an action on the reproductive system opposite to that of the pituitary.

#### ECCRINE SWEAT GLAND



**Figure 12**

- **The parathyroids:** elaborate parathormones.
- **The endocrine pancreas:** constituted by the islets (cells) of Langerhans. The hormones elaborated are insulin, glucagon, and somatostatin.
- **The adrenal glands:** formed of 2 distinct parts: the adrenal cortex (cortisol and aldosterone) and the adrenal medulla (adrenaline and noradrenaline).
- **The ovaries:** oestrogens = theca interna; progesterone = corpus luteum.

### III. Amphicrine Glands

Possessing both endocrine and exocrine structures. There are 2 types:

- **Homotypic amphicrine gland:** the same type of identical cells ensures both the endocrine and exocrine function. (Hepatocytes elaborate bile = exocrine, and coagulation factors = endocrine.)
- **Heterotypic amphicrine gland:** two different cell types (serous cells of the exocrine pancreas and peptic cells of the endocrine pancreas).

### SECRETORY CYCLE OF A GLANDULAR CELL

- **Resting phase:** uptake of precursors from blood vessels, followed by regeneration of lost organelles required for new syntheses.
- **Secretory phase:** synthesis of specific products, followed by their intracellular storage in various forms (granules, vacuoles, etc.).
- **Excretory phase:** discharge of the synthesized product either into the extracellular matrix (ECM), directly into the blood or lymph, or into the immediate extracellular space intended for neighboring cells.

### MYOEPIHELIAL CELLS

- These are muscular cells of epiblastic origin with a stellate morphology (star-shaped) and cytoplasmic expansions.
- Located between the basal lamina and the basal plasma membrane of the secretory epithelial cells.

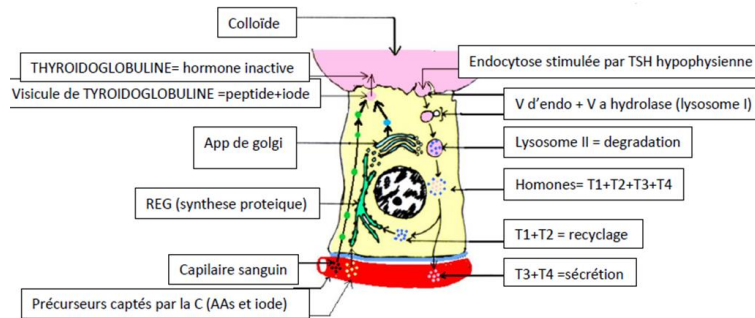


Figure 13

**Role:** contraction to expel the product from an exocrine gland.

### The APUD System (Amine Precursor Uptake Decarboxylation)

This is a diffuse neuroendocrine system (neuro = controlled by the central nervous system; endocrine = elaborates hormones; diffuse = its cells are dispersed within an organ).

- **Origin:** neural crests; currently it is believed that they derive from undifferentiated cells of the epithelia.
- **Localization:** its cells are isolated within the epithelia (as is the case in the respiratory system, salivary glands, and digestive glands). They are always oriented toward blood vessels.

**Role:** the cells take up amino acids and decarboxylate them, with the purpose of secreting polypeptide hormones that act locally (ex: gastrin).