

Lecture one:

## **Introduction to General Histology**

Histology is the microscopic study of various tissues of the body. A tissue is made up of groups of cells performing the same function.

### **Body components**

1- Cell: smallest living unit of organization in the body, since each cell is capable of performing necessary functions by its living components:

Epithelial cell, neuron, myofibril, chondrocyte, osteocyte, fibroblast, erythrocyte, macrophage.

2- Tissue: collection of similarly (form and function) specialized cells are grouped together:

Epithelium, nervous tissue, muscle, cartilage, bone, connective tissue, blood.

3- Organ: various tissue types are bounded together to form independent body part that performs a specific function.

Skin, brain, heart, liver.

4- System: many organs are functioning together.

CNS, RS, IS, CVS.?

### **Cells:**

Each cell has a cell membrane, cytoplasm, organelles, and inclusions. **Cell membrane** surrounds the cell and acts as a barrier between the tissue fluid (extracellular fluid) and the cytoplasm (intracellular fluid and organelles).

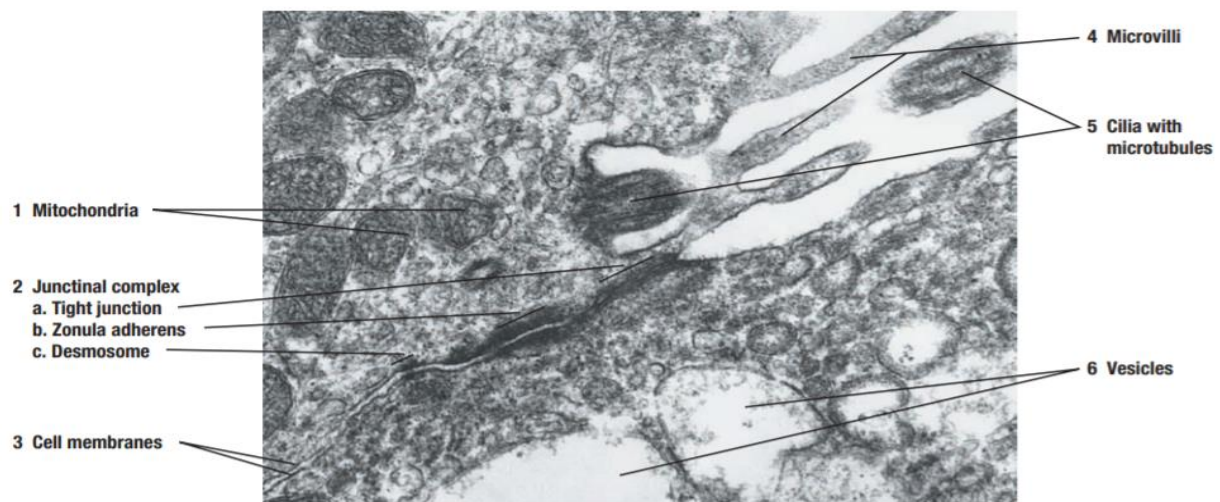
**Cytoplasm** consists of a cytoplasmic matrix with organelles and inclusions suspended in it. Organelles are living units while the inclusions are non-living entities. The major cytoplasmic organelles are the endoplasmic reticulum, Golgi apparatus, mitochondria, lysosomes, ribosomes and cytoskeleton.

**Inclusions:** lipids, glycogen (energy sources) and melanin (pigment source). Also Many of inclusions include bodies, which are spent lysosomes and their digested material.

### **Intercellular junctions**

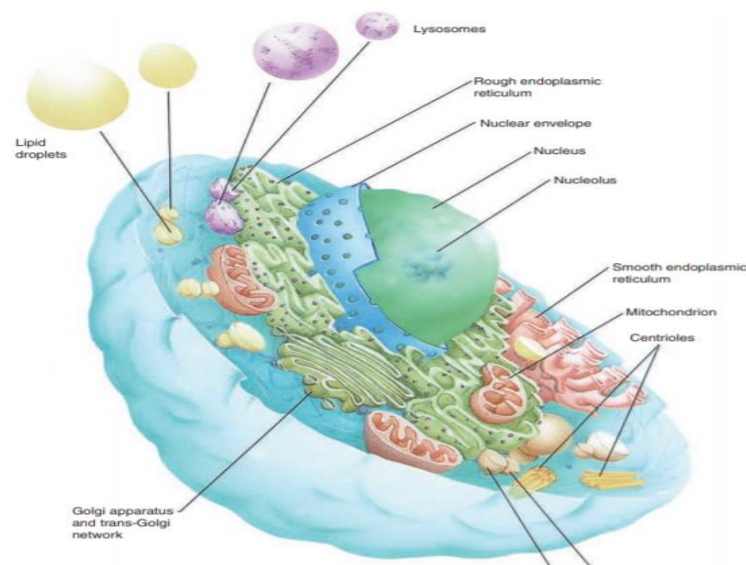
Mechanical attachments formed between cells, and also between cells and adjacent noncellular surfaces. All intercellular junctions involve attachment device, which includes an attachment plaques and tonofilaments.

An intercellular junction between cells is formed by desmosome, while attachment of a cell to an adjacent noncellular surface is formed by hemidesmosome.



Junctional complex between epithelial cells.  $\times 31,200$ .

These are characterised by local thickening of the adjacent cell membrane of the two cells. Desmosomes are bands present below and parallel to the tight junctions. These strongly anchor one cell to the next one. Hemidesmosomes are present at the basal border of the cells. These help to attach the cells firmly to the underlying basement membrane.



## **Basic Tissues**

Tissue types are categorized according to four basic histological types includes epithelial, connective, muscle, and nerve tissue.

Tissue	Types	Subcategories
Epithelium	Simple	Squamous, cuboidal, columnar, pseudostratified
	Stratified	Squamous (keratinized, nonkeratinized) Cuboidal, columnar, transitional.
Connective tissue	Solid soft	Connective tissue proper, specialized Adipose, fibrous, elastic, reticular
	Solid firm	Cartilage
	Solid rigid	Bone
	Fluid	Blood, lymph
Muscle	Involuntary	Smooth, cardiac
	Voluntary	Skeletal
Nerve	Afferent	Sensory
	Efferent	Motor

Regeneration refers both to the regular and repeated renewal of a particular structure or tissue throughout the life of an organism, that is, the cellular renewal that occurs during normal aging (also called tissue homeostasis or physiological regeneration), as well as to restoration of injured tissue or lost body. Epithelial proliferation is the term given to the ability of any epithelium to be able to renew itself after cells die, that is, the ability to turnover cells. This occurs in the stratum basale, which is situated on deepest layer of cells in thin epithelia (e.g. the bottom of the mouth), and in the lower two to three cells layers of thicker epithelia (e.g. buccal mucosa or inside of the cheek).

cell type	turnover time
small intestine epithelium	2-4 days
stomach	2-9 days
blood Neutrophils	1-5 days
white blood cells Eosinophils	2-5 days
gastrointestinal colon crypt cells	3-4 days
cervix	6 days
lungs alveoli	8 days
tongue taste buds (rat)	10 days
platelets	10 days
bone osteoclasts	2 weeks
intestine Paneth cells	20 days
skin epidermis cells	10-30 days
pancreas beta cells (rat)	20-50 days
blood B cells (mouse)	4-7 weeks
trachea	1-2 months
hematopoietic stem cells	2 months
sperm (male gametes)	2 months
bone osteoblasts	3 months
red blood cells	4 months
liver hepatocyte cells	0.5-1 year
fat cells	8 years
cardiomyocytes	0.5-10% per year
central nervous system	life time
skeleton	10% per year

## Lecture two:

## Epithelium

Epithelium (plural, epithelia) consists of sheets of cells that cover the external surfaces of the body, line the internal cavities, form various organs and glands, and line their ducts. Epithelial cells are in contact with each other, either in a single layer or multiple layers. The structure of lining epithelium, however, differs from organ to organ, depending on its location and function. For example, epithelium that covers the outer surfaces of the body and serves as a protective layer differs from the epithelium that lines the internal organs.

### Major Features

- Classification based on number of cell layers and cell morphology
- Basement membrane separates epithelium from connective tissue
- All epithelia are nonvascular; delivery of nutrients to cells and removal of metabolic waste occurs via diffusion
- Surface modifications include motile cilia, microvilli, and stereocilia

### FUNCTIONS OF EPITHELIAL TISSUE/EPITHELIUM

1-**Protective:** The stratified squamous keratinized epithelium of skin offers mechanical protection including conservation of moisture.

2-**Secretory:** The glands which are derivatives of the epithelium secrete useful chemical substances.

3-**Absorptive:** Epithelia of small intestine and of proximal convoluted tubules of kidney are modified to specialize in absorptive functions.

4-**Excretory:** Epithelium of distal convoluted tubules and collecting ducts of kidney function as excretory organs.

5-**Sensory:** The rods and cones of retina and hair cells of olfactory mucous membrane are specialized sensory cells.

Importantly, for dental professionals, both the epithelium of the skin and oral mucosa are of similar ectodermal origin. In comparison, those lining the respiratory and digestive tract are of endodermal origin, and those lining the urinary tract are derived from mesoderm.

## **Types of Epithelia**

### **Simple Epithelium**

Simple squamous epithelium that covers the external surfaces of the digestive organs, lungs, and heart is called mesothelium. Simple squamous epithelium that covers the lumina of the heart chambers, blood vessels, and lymphatic vessels is called endothelium.

Simple cuboidal epithelium lines small excretory ducts in different organs. In the proximal convoluted tubules of the kidney, the apical surfaces of the simple cuboidal epithelium are lined with a brush border consisting of microvilli.

Simple columnar epithelium covers the digestive organs (stomach, small and large intestines, and gallbladder). In the small intestine, simple columnar absorptive cells that cover the villi also exhibit microvilli. Villi are fingerlike structures that project into the lumen of the small intestine. In the female reproductive tract, the simple columnar epithelium is lined with motile cilia.

### **Pseudostratified Columnar Epithelium**

Pseudostratified columnar epithelium lines the respiratory passages and lumina of the epididymis and vas deferens. In trachea, bronchi, and larger bronchioles, the surface cells exhibit motile cilia; in the epididymis and vas deferens, the surface cells exhibit nonmotile stereocilia, which are branched or modified microvilli.

### **Stratified Epithelium**

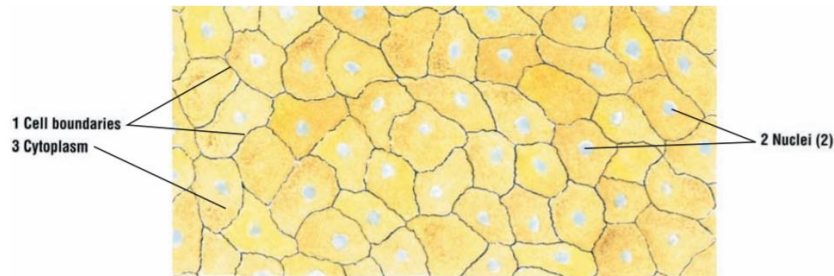
Stratified squamous epithelium contains multiple cell layers. The basal cells are cuboidal to columnar; these cells give rise to cells that migrate toward the surface and become squamous. There are two types of stratified squamous epithelia: nonkeratinized and keratinized.

Nonkeratinized epithelium exhibits live surface cells and covers moist cavities such as the mouth, pharynx, esophagus, vagina, and anal canal. Keratinized epithelium lines the external surfaces of the body. The surface layers contain nonliving, keratinized cells that are filled with the protein keratin. The exposed epithelium that covers the palms and soles exhibits especially thick layers of keratinized cells.

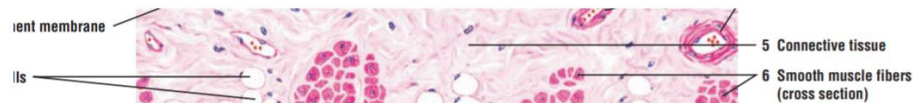
Stratified cuboidal epithelium and stratified columnar epithelium have a limited distribution in the body. Both types of epithelia line the larger excretory ducts of the pancreas, salivary glands, and sweat glands. In these ducts, the epithelium exhibits two or more layers of cells.



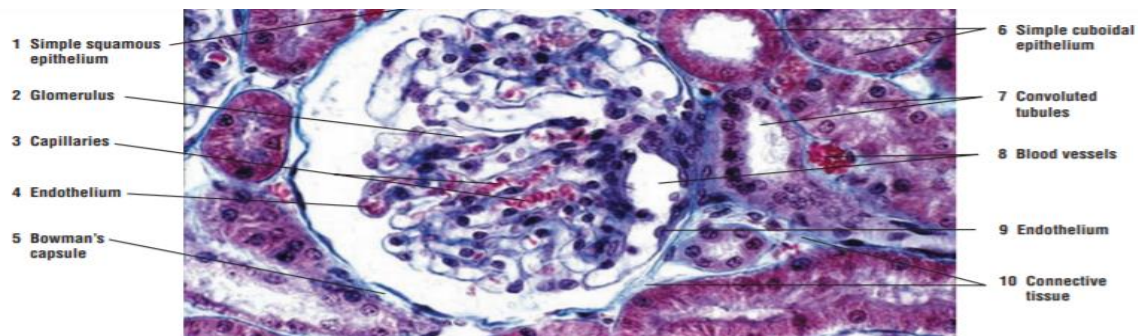
Transitional epithelium lines the minor and major calyces, pelvis, ureter, and bladder of the urinary system. This type of epithelium changes shape and can resemble either stratified squamous or stratified cuboidal epithelia, depending on whether it is stretched or contracted. When transitional epithelium is contracted, the surface cells appear dome-shaped; when stretched, the epithelium appears squamous.



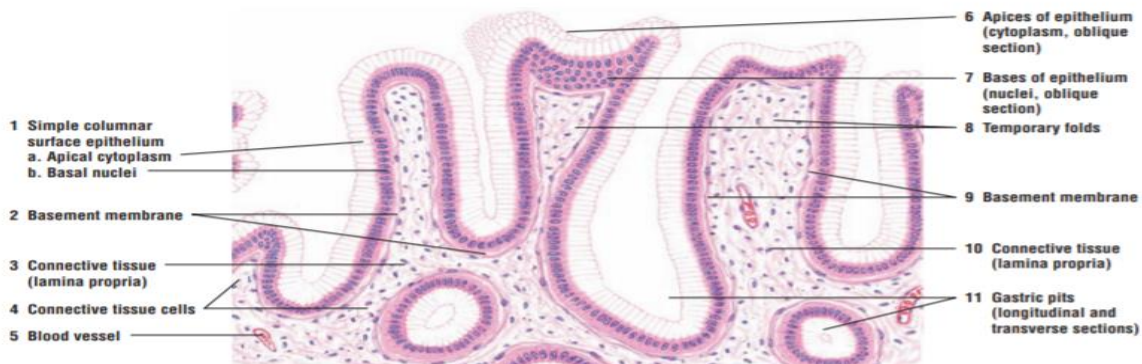
**FIGURE 2.1** ■ Simple squamous epithelium: surface view of peritoneal mesothelium. Stain: silver nitrate with hematoxylin. High magnification.



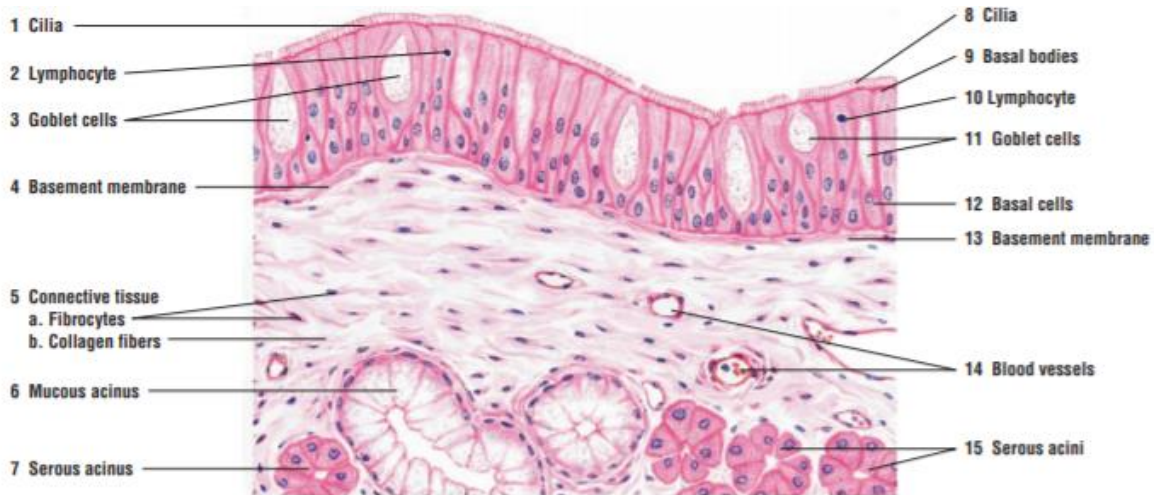
**FIGURE 2.2** ■ Simple squamous epithelium: peritoneal mesothelium surrounding small intestine (transverse section). Stain: hematoxylin and eosin. High magnification.



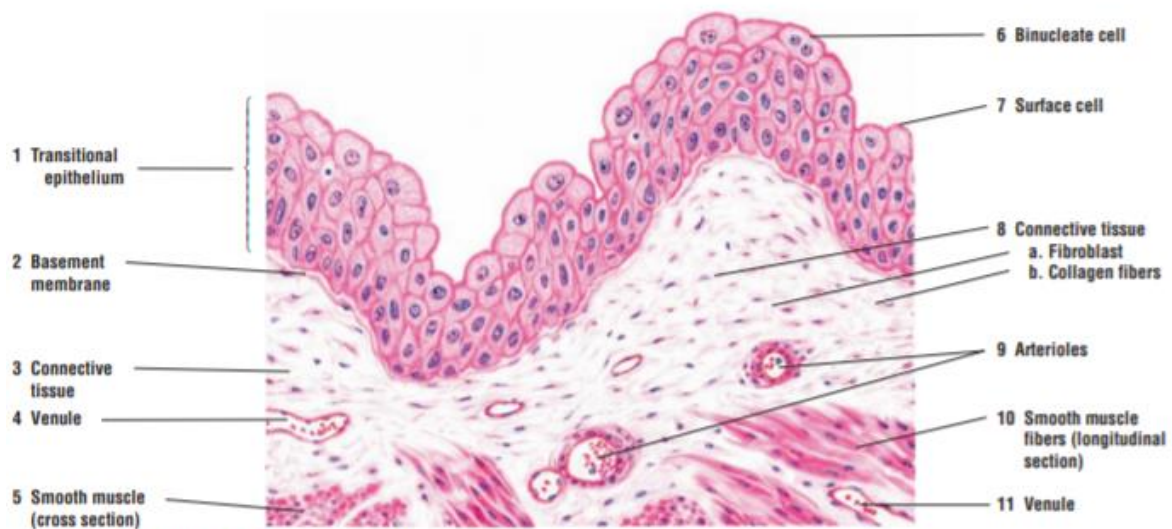
**FIGURE 2.3** ■ Different epithelial types in the kidney cortex. Stain: Masson's trichrome.  $\times 120$ .



**FIGURE 2.4** ■ Simple columnar epithelium: surface of stomach. Stain: hematoxylin and eosin. Medium magnification.

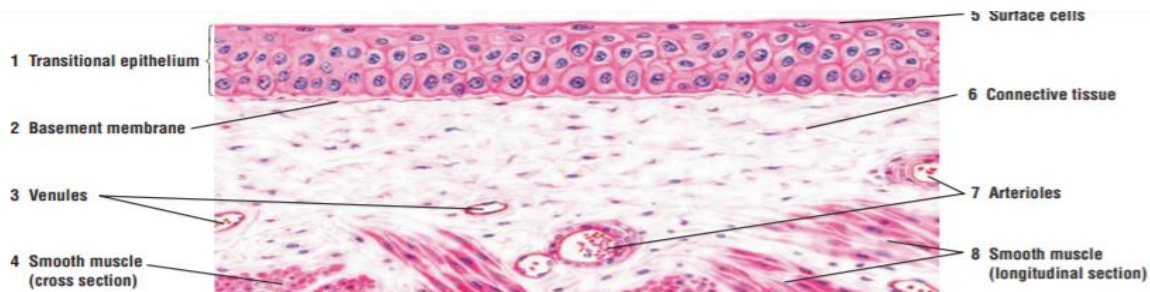


**FIGURE 2.6** ■ Pseudostratified columnar ciliated epithelium: respiratory passages—trachea. Stain: hematoxylin and eosin. High magnification.

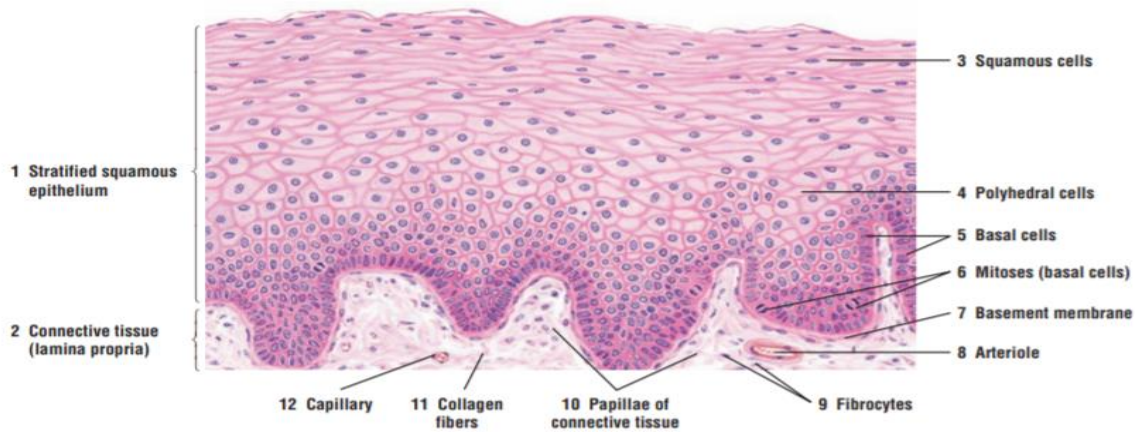


**FIGURE 2.7** ■ Transitional epithelium: bladder (unstretched or relaxed). Stain: hematoxylin and eosin. High magnification.

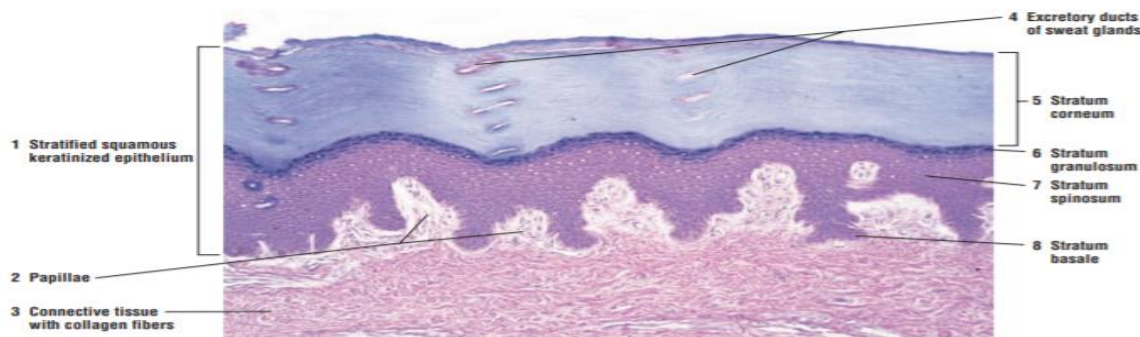




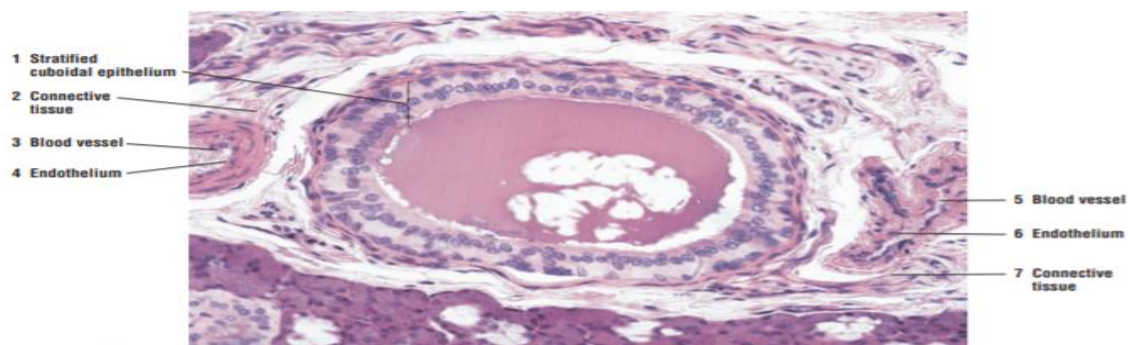
**FIGURE 2.8** ■ Transitional epithelium: bladder (stretched). Stain: hematoxylin and eosin. High magnification.



**FIGURE 2.9** ■ Stratified squamous nonkeratinized epithelium: esophagus. Stain: hematoxylin and eosin. Medium magnification.



**FIGURE 2.10** ■ Stratified squamous keratinized epithelium: palm of hand. Stain: hematoxylin and eosin.  $\times 40$ .



**FIGURE 2.11** ■ Stratified cuboidal epithelium: excretory duct in salivary gland. Stain: hematoxylin and eosin.  $\times 100$ .