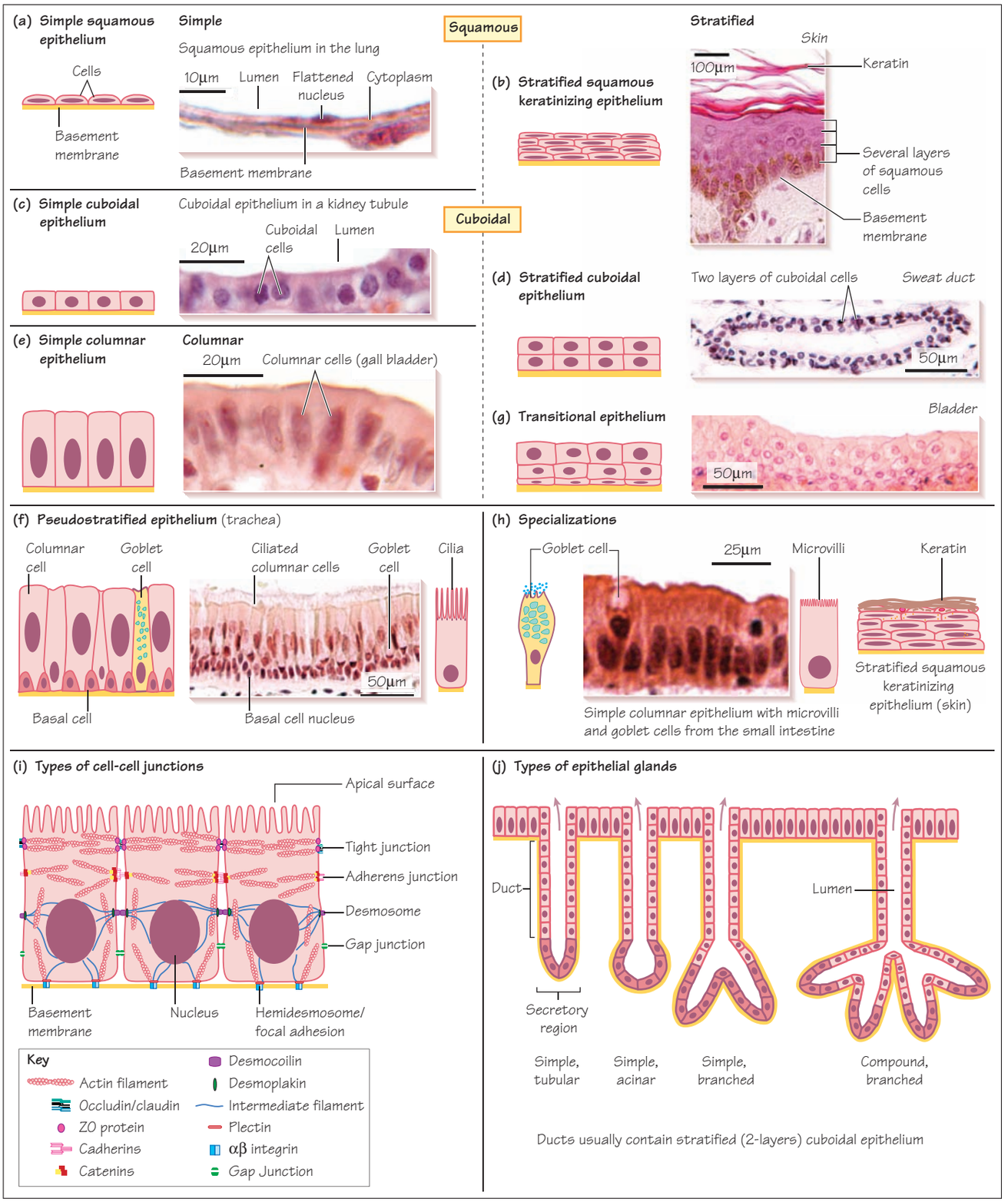
7 Epithelium



Functions of epithelium

The epithelium covers or lines all of the internal and external body surfaces (i.e., skin, nasal cavity, gut, etc).

The epithelium acts as a barrier, controlling:

- diffusion across the epithelium;
- absorption by epithelial cells;
- secretion of substances onto the outside of the epithelium.

The epithelium also provides physical protection.

The epithelium consists of a continuous sheet of one or more layers of cells that are tightly connected to each other, and to the underlying layer of connective tissue (the basement membrane). The epithelium is **avascular**. Cells rely on diffusion across the basement membrane for their nourishment.

Classification of epithelium

Epithelium is classified as either:

- **simple** (one layer of cells); or
- **stratified** (two or more layers of cells);

and on the basis of cell shape as either:

- **squamous:** contains flat cells (width is much greater than the height). This facilitates transport and rapid diffusion across the epithelium.
- **cuboidal:** square/cuboidal cell shape. These cells usually active in excretion, secretion or absorption, and the Golgi and organelles lie between the nucleus and the apical surface.
- **columnar:** height is greater than width. These cells are highly active in secretion.

A simple squamous epithelium (Fig. 7a) lines the lungs, and all blood vessels (where it is called the **endothelium**), and forms the **mesothelial** lining of all the body cavities.

A stratified squamous epithelium (Fig. 7b) protects against abrasion. Examples include the epithelium of skin and the oesophagus.

A simple cuboidal epithelium (Fig. 7c) lines secretory regions of some glands, and tubules in the kidney.

A stratified cuboidal epithelium (Fig. 7d) lines the excretory regions of glands, e.g., the sweat glands of skin.

A simple columnar epithelium (Fig. 7e) lines the stomach (and the gall bladder).

Pseudostratified epithelium

This is a simple epithelium that looks stratified (Fig. 7f) because the nuclei of the cells that make up this type of epithelium are found at different levels, giving it a stratified appearance. It contains columnar cells that span from the basement membrane to the lumen, and smaller basal cells (stem cells that renew the epithelium) with basally located nuclei.

Transitional epithelium

This is a stratified epithelium (Fig. 7g) in which the cells change their appearance, appearing cuboidal in relaxed epithelium and squamous when the epithelium is stretched.

Specializations of the epithelium

- **Microvilli:** small thin protrusions on the apical surface of cells, which contain bundles of actin filaments, and increase the surface area of the cell for absorption (Fig. 7h).
- **Cilia:** long fine projections on the apical surface that contain a core of microtubules. Motile cilia beat rhythmically, moving mucus on the apical surface of cells (Fig. 7f).
- **Goblet cells:** Specialized epithelial cells that secrete mucus (glygoproteins and proteoglycans) onto the apical surface of the epithelium. These are single 'glandular' cells (Fig. 7h).
- **Keratin:** found on the outer surfaces of epithelia that experience abrasion and water loss. Keratin is a type of intermediate filament, which is made and secreted by epithelial cells in a highly crosslinked form onto the outermost surface (Fig. 7h).

Connections within the epithelium

Four main types of junction (Fig. 7i) connect epithelial cells to each other.

- **Tight junctions** are close to the apical surface.
- **Adherens junctions** are just below the apical surface. Both tight and adherens junctions involve actin filaments.
- **Desmosomes** involve intermediate filaments.
- **Gap junctions** are communicating junctions (not structural) for communication.

These cell–cell junctions are important for maintaining the integrity of the epithelium.

Hemidesmosomes (focal adhesions) are junctions/connections that connect the basal layer of the epithelium to the underlying basement membrane.

Epithelial glands

Epithelial cells can become specialized to form glands (Fig. 7j). These are either:

- **exocrine** glands (secretions released via ducts); or
- **endocrine** glands (ductless; secretions released directly into the bloodstream).

Exocrine glands are classified as:

- simple (unbranched duct); or
- compound (branched ducts).

Secretory regions of glands can either be:

- tubular (alveolar, e.g., sweat glands) or
- acinar (shaped like a grape, e.g., salivary glands).

Secretions are released via:

- exocytosis (**merocrine** secretion, i.e. sweat glands);
- rupture of the entire cell, and release of its products (**holocrine**, i.e. sebaceous glands);
- a mixture of the above (**apocrine**, a third rare type of secretion).

Secretions can either be:

- **serous** (watery);
- **mucous** (viscid, contains glycoproteins); or
- a mixture of the two.