I. Levels of organization

A. The human body has many levels of structural organization. Beginning with the smallest:

1. Chemical level: Examines atoms and how they combine to form the molecules of the human body (water, sugar, protein, DNA).
2. Cellular level: Examines **cells** (the most basic structural and functional unit of any living thing).
3. Tissue level: Examines the 4 types of **tissues** (group of two or more cells of similar function or origin).
   - **a. Epithelia**
   - **b. Connective**
   - **c. Nervous**
   - d. **Muscle**
4. Organ level: Examines **organs** (a structure composed of at least 2 major tissue types) and their specific function for the body.
5. System level: Examines how 2 or more organs work together, each with a specific function, to accomplish a common purpose (ex. Cardiovascular system, Digestive system).
6. Organismal level: Examines how all of the organ systems function together to promote life.

II. Tissues:

A.Epithelia

1. Location:
   - a. **Covers** body surfaces and organs
   - b. **Lines** closed body cavities and hollow organs
   - c. Forms **glands**
     - i. Usually associated with cuboid (sometimes columnar) epithelia.
     - ii. Supported by reticular C.T.
     - iii. Classified as **endocrine** or **exocrine**.
       - (a) Endocrine glands:
         - (i) Consist of **ductless** glands that secrete hormones into the circulatory system.
         - (ii) Includes the pituitary gland, adrenal gland, ovary, etc.
       - (b) Exocrine glands:
         - (i) Consist of glands **with a duct** that secrete onto a free surface of the body (skin) or into the lumen (interior space) of a hollow organ (stomach, mouth, etc.).
         - (ii) Includes sweat glands, salivary glands, mammary glands, etc.
2. Functions:
   - a. Protection
   - b. Secretion
   - c. Absorption
3. Characteristics:
   - a. Cells are very simple, 6-sided, and closely packed together. There are 3 types of epithelial cells:
     - (i) **squamous**: flat cells with a disc shaped nucleus
     - (ii) **cuboid**: cube shaped with a spherical nucleus

(iii)columnar: rectangular cells with an elongate nucleus

b. Tissue has an **apical** (free) surface which is exposed to a body cavity or the exterior of the body; and a **basal** surface which is attached to an underlying **basement membrane** (connective tissue).
c. Typically highly mitotic
d. No blood vessels are present (**avascular**).
e. Nerves may be present.

4. Tissue arrangements:
   a. **Simple**: a single layer of cells found in areas where diffusion, filtration, secretion and absorption occur. Found in areas of low wear and tear.
      i. simple squamous:
         (a) Has a fried-egg appearance.
         (b) Helps in forming membranes that line closed cavities and cover organs within those cavities; forms walls of capillaries and alveoli within the lungs.
      ii. simple cuboidal:
         (c) Primarily associated with glands and their ducts. Also covers the ovary and lines ducts of the kidney.
      iii. simple columnar:
         (d) Lines open tracts , i.e. digestive and reproductive tracts.
         (e) May be specialized with **microvilli** for absorption.
         (f) Has **goblet cells** for mucous production.
   b. **Stratified**: contains 2 or more layers of cells. Found in areas of high wear and tear.
      i. Stratified squamous:
         (a) Forms outer layer of skin and lines body openings (mouth, esophagus, vagina (nonkeratinized), anal canal (keratinized).
         (b) Sloughs easily to reduce friction.
      ii. Stratified cuboidal:
         (a) Fairly rare.
         (b) Forms ducts of sweat glands and lines male urethra.
      iii. Stratified columnar:
         (a) Fairly rare.
         (b) Lines part of the male urethra and forms part of the conjunctiva of the eye.
   c. **Transitional**:
      i. Specialized to undergo changes in tension.
      ii. Looks similar to stratified cuboidal with larger, rounded cells at the apical surface.
      iii. Cells flatten as tissue is stretched. Lines the ureters and urinary bladder.
   d. **Pseudostratified**: A single layer of cells where some cells do not reach the surface. This causes the tissue to appear to be multilayered.
      i. Pseudostratified ciliated columnar: Lines the airway of most of the respiratory system and some ducts in the reproductive system.

5. Cancer
   a. 90% of all cancers are associated with epithelial cells.
   b. Most cases develop on surfaces exposed to the external environment.