

Cell Modifications and Specialization

- Cells vary in appearance to perform specific functions
- The presence and number of organelles vary per cell based on their function
i.e. cells of the testes and ovaries have higher numbers of SER organelles because they synthesize testosterone and estrogen respectively
- Multicellular organisms make use of cell differentiation to let newly formed, undifferentiated cells called stem cell, be structurally modified to perform specialized functions
- Specialized cells form tissues, which form specific organs, and when working together create an organ system that allow an organism to function
- Plant and animal tissues differ in number and complexity

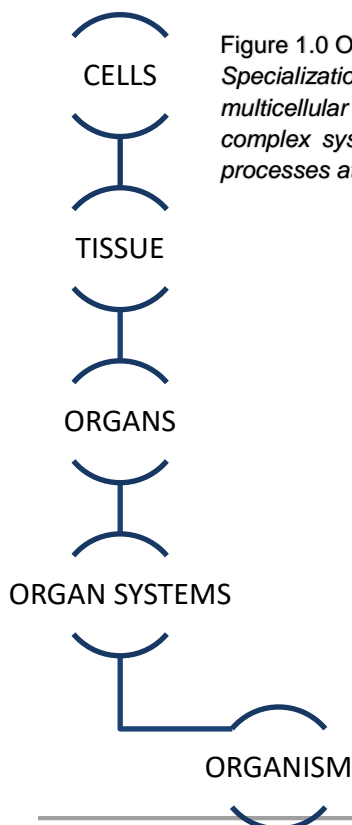


Figure 1.0 Organization of Cells
Specialization of cells allow multicellular organisms to have complex systems to perform different processes at the same time

I. Plant Cells and Tissues

- Plant cells can create simple or complex tissues, wherein they consist of only one type of multiple types of cells respectively
- All new plant cells arise from Meristems, which is a region of actively dividing tissue. From these meristems, cells and tissue differentiate into Permanent tissues, which are specialized to perform specific functions. They are divided into 3 types: the ground, vascular, and ground

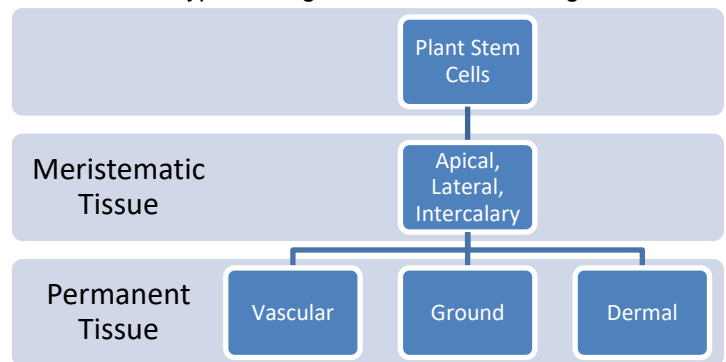


Figure 2.0 Organization of Plant Tissues

Meristematic Tissues

- Regions of plant growth via active/constant mitosis
- Meristematic cells are small, thin cell walls, no central vacuole, large nucleus, and dense cytoplasm

1. Apical meristems

Occur in the tips of roots (root apical meristem/root apex) and shoots (shoot apical meristem/shoot apex) of the plants. Responsible for the extension of the plant's length or the primary growth

2. Lateral meristems

Occur in the entire length of the stems and roots except for the tips. It is also known as the cambium. Responsible for

the increase in girth or the secondary growth.

It consists of the vascular cambium and the cork cambium

3. Dermal meristems

Only found in monocotyledons, and they occur between mature tissue sections near stem internodes or leaf attachments

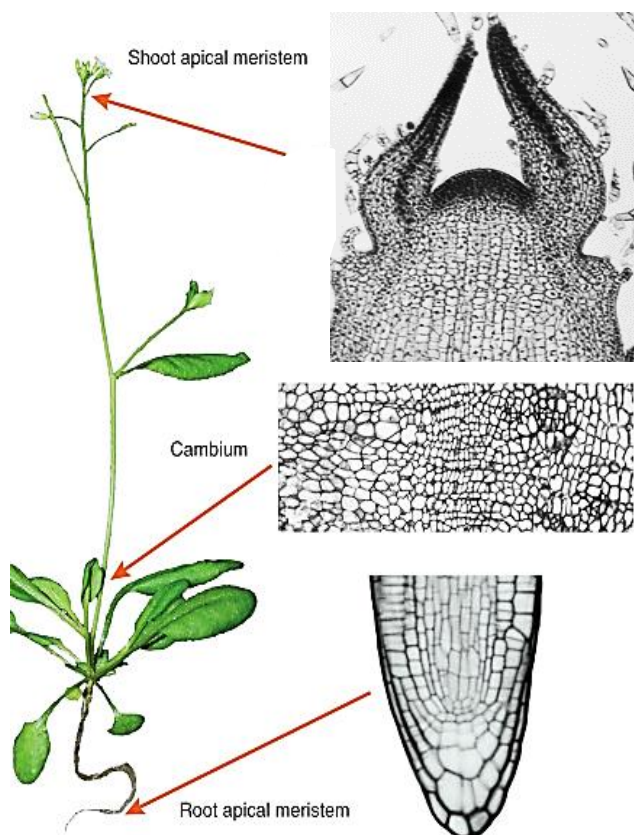


Image 2.0 Micrographs of Apical and Lateral Meristems, and their Location

Source: <https://www.sciencedirect.com/science/article/pii/S0960982216308648>

Source: http://www.bio.miami.edu/dana/226/226_F09_7print.html

Permanent Tissue

- From differentiated meristems to perform specific functions like protection, support, storage, and transport of nutrients

1. Ground Tissue

The most abundant tissue in plants. Classified as either Parenchyma (the most abundant in all non-woody plants. Cells are not very specialized and function as either food manufacturers, storage, photosynthesis, respiration, and repair of damaged cells), Collenchyma, (uneven thickness of cells, flexible, and fully permeable to water. Provides elastic support for growing stems and leaves), and Sclerenchyma (consists of dead cells present in plants that have stopped growing, mainly for structural and inelastic support)

2. Dermal Tissue

Present in the outer covering of plants. Consists of the outermost layer called the epidermis which functions to cover and protect the plant by secreting a wax called the cuticle. The layer beneath the epidermis is the periderm, or bark. It functions as additional protection, regulates water loss, and gas exchange.

3. Vascular Tissue

Transports water and nutrients throughout the plant. It has two types: the Phloem (which transports the nutrients and dissolved organic compounds by means of sieve tube elements and companion cells), and the Xylem (which transports water and dissolved minerals by means of Tracheid and vessel elements)

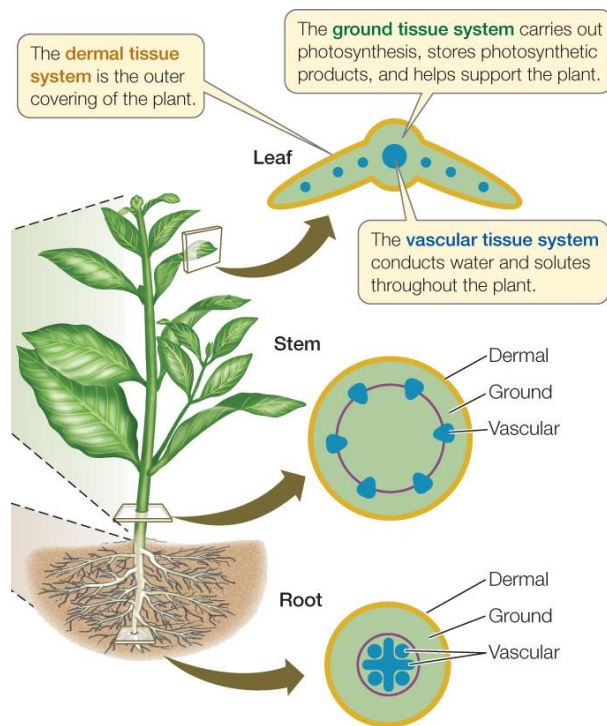


Image 2.1 Diagram of Ground, Dermal and Vascular Tissues, and their Location

Source: www.macmillanhighered.com/BrainHoney/6716/digital_first_content/trunk/test/hillis2e/asset/img_ch24/c24_fig06.html

II. Animal Cells and Tissues

- Animal tissues are classified depending on their structure, origin
- Composed of 4 broad categories:

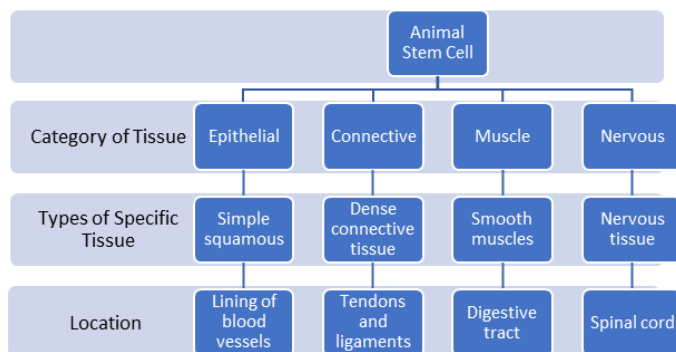


Figure 3.0 Organization of Animal Tissues

Epithelial Tissues

- Widespread throughout the body. Mainly function to cover all surface, line body cavities and hollow organs.
- Consists of closely packed, flat cells, with little intercellular space. They are attached to neighboring cells by junctions
- Can be further classified based on the number of cells that compose it: Simple epithelium (only one cell thick), Stratified epithelium (two or more cells thick), and Pseudostratified epithelium (one cell thick, but cells are of different sizes which makes it look like there are numerous cells)
- Can be further classified based on cell shape: Squamous, Cuboidal, or Columnar
- Sample locations include skin, lining of digestive tract, lining of urethra, and excretory glands

Connective Tissues

Most widespread tissue in the body because it consists of cells that are embedded within the extracellular matrix

Functions include filling spaces, attaching epithelium to other tissues or organs, protecting and cushioning organs, and provides flexible structural support

Varies greatly in structure and function. Can be seen as either loose connective tissue, dense connective tissue, cartilage, bone, adipose, and even blood.

These tissues consist more of the matrix rather than cells (with the exception of adipose)

Muscle Tissue

Specialized tissue with abundant mitochondria in their cells due to their need to contract and shorten in order to move organs or tissue.

Can be classified as voluntary or involuntary based on their function. Can also be classified as striated or smooth based on their structure

Animals have three main types of muscle tissues:

a. Smooth muscles: or visceral muscle.

These do not have cross striations and consist of multiple sheets of spindle shaped fibers called muscle fibers. It is involuntary and forms the muscles of hollow organs, blood vessel walls, and ducts of various glands. It functions to provide slow and sustained contractions.

b. Skeletal muscles

Most abundant tissue in the vertebrate body. These cells are striated and have multiple nuclei per strand. It is voluntary. Each muscle consists myofibrils that lie parallel to each other. Myofibrils are made of myofilaments, mainly actin and myosin. These muscles can be seen attached to bone and provide coordinated movements of the skeleton, maintain body posture, and regulate body temperature

c. Cardiac muscle

These can only be found in the heart walls. It is striated and have

intercalary discs which connect neighboring fibers together. It is involuntary and myogenic, meaning that contraction is initiated by the muscle itself, not an external stimulus. It provides contractions of the atria and ventricles of the heart.

Nervous Tissue

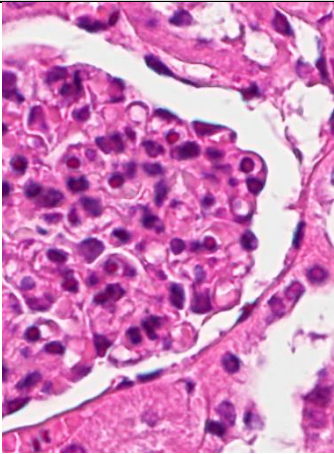
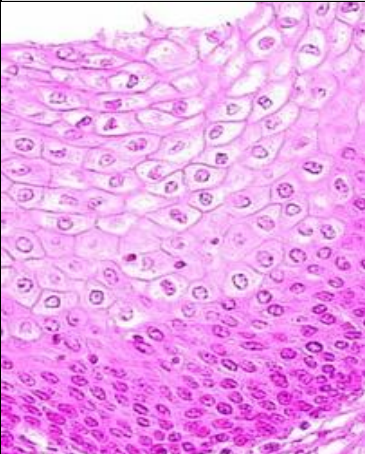
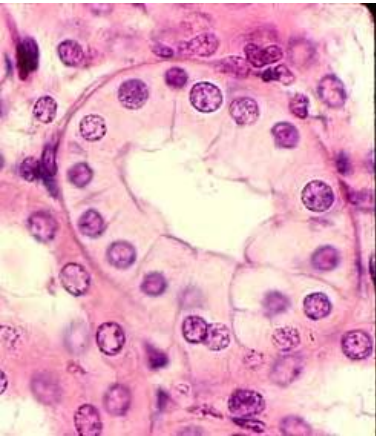
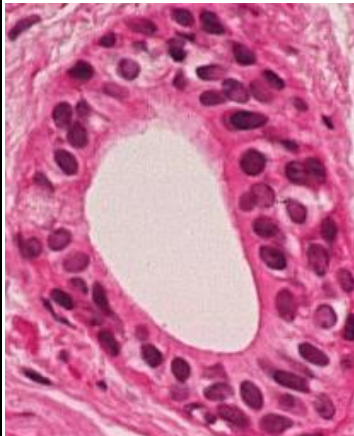

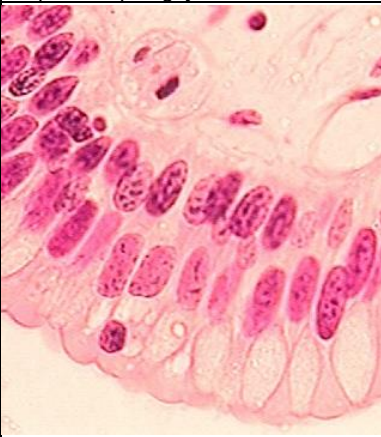
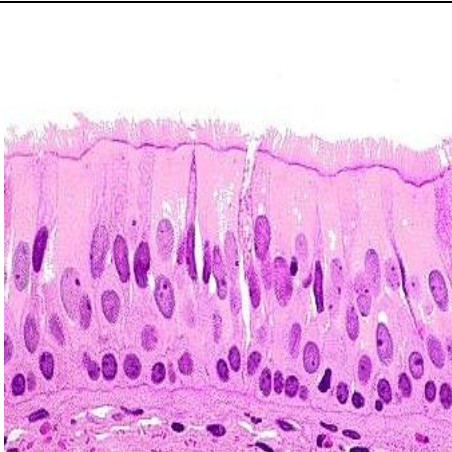
Found in the brain, spinal cord, and nerves. It provides coordination and control over body activities and responses. These cells are amitotic, meaning that they do not undergo mitosis and so cannot be replaced if destroyed. The main units of the nervous system are:

a. Neurons

Basic structural unit of the nervous system. Forms communication networks that receive, process, and transmit information. Can be classified as either Sensory (afferent) which carries information from sensory organs to the CNS, Motor (efferent) which carries information from the CNS to the effectors (muscles, glands), or Interneurons which connects one neuron with another

b. Neuroglia

Nerve cells that do not transmit information, rather they support the neurons. Vertebrates showcase 2 types of neuroglia: Oligodendrocytes, and Schwann Cells

EPITHELIAL TISSUES			
	SIMPLE	STRATIFIED	PSEUDOSTRATIFIED
SQUAMOUS	 <p>Bowman's Capsule Source: http://webshares.northseattle.edu</p>	 <p>Esophagus Source: http://microanatomy.net/</p>	Rarely Found. Not usually present.
CUBOIDAL	 <p>Kidney (medulla) Source: http://www.siumed.edu</p>	 <p>Sweat Glands Source: http://www.pathguy.com/histo/081.html</p>	Rarely Found. Not usually present.
COLUMNAR	 <p>Small Intestine Source: https://www.photos.com/</p>	 <p>Salivary Glands Source: http://mrhardinsclass.weebly.com/</p>	 <p>Trachea Source: http://stevegallik.org</p>

References

Hoefnagels, M. (2016). *General Biology (Books I & II)*. McGrawHill Education. Pp 424-426, 462-465

Morales-Ramos, A., & Ramos, J. (2017). *General Biology 1*. Phoenix Publishing House. pp 65-66

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DEFINITIONS BOX

Cell differentiation

Stem Cells

Meristems

Epithelial Tissue

Connective Tissue

Muscular Tissue

Nervous Tissue

Extracellular Matrix
