

Exercise 3: Tissues

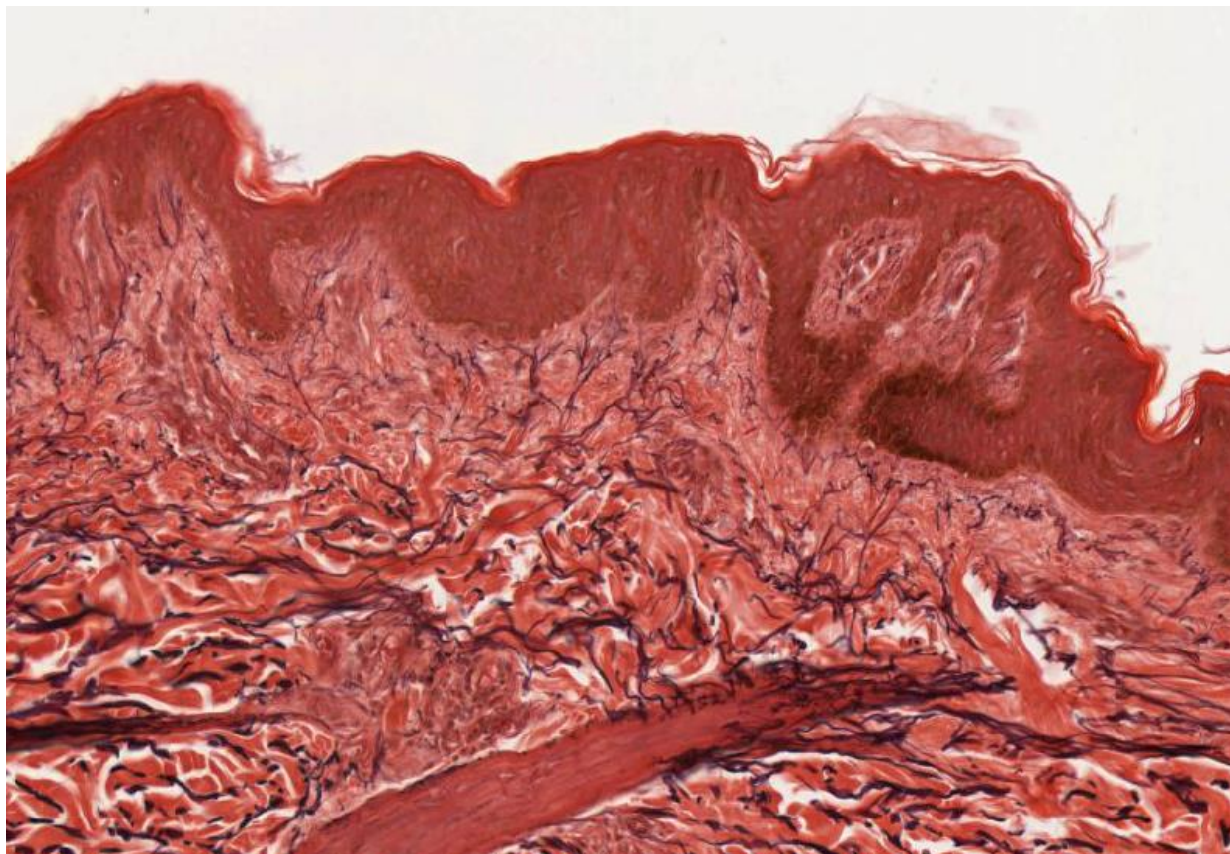


Figure 3.1 The histological image above is the skin, which is made up of four types of tissues: epithelial, connective, nervous, muscle.

http://virtualslides.med.umich.edu/Histology/Integumentary%20System/107_HISTO_40X.svs/view.apml?cwidth=817&cheight=1021&chost=virtualslides.med.umich.edu&csis=1&X=0&Y=0&zoom=4.09417768499188&listview=1

Exercise 3 Learning Goals

After completing this lab you should be able to:

- Describe the four types of tissues found in the human body.
- Explain how the tissues differ from one another.
- Describe the different types of glands and how each function.
- Describe the different junctions found between cells.
- Describe the relationship between form and function regarding the different types of tissues.
- Using your knowledge of the tissue types, identify each type from histological images.
- Be able to give examples of different tissue types and where each are found in the human body.

Pre-Laboratory Exercise 3

Pre-Lab Activity 3.1

Use your text book or the web resources listed below to explore the four types of tissues. In the chart below, list the four types of tissues and describe how each differs, making sure to include notable features of each.

Web Resources:

https://www.histology.leeds.ac.uk/tissue_types/index.php

<https://www.khanacademy.org/science/high-school-biology/hs-human-body-systems/hs-body-structure-and-homeostasis/a/tissues-organs-organ-systems>

<i>Tissue Type</i>	Physical Characteristics (cell density, interstitial space/ special features; functional significance)	Examples in the Human Body	Subdivisions within Type
<i>Epithelial</i>	Cells in high density; little to no interstitial space; lines tubules (lumen present) or covers outer surface (free apical edge); functions for protection, excretion, absorption	Skin, lining digestive track, airways, serous membranes, glands	Simple (single layer) Stratified/Complex (double layer or more) Squamous (flat) Cuboidal (cube-shaped) Columnar (rectangular) Transitional (can change shape)
<i>Connective</i>			

<i>Muscle</i> <i>-skeletal</i> <i>-cardiac</i> <i>-smooth</i>			
<i>Neural</i>			

Pre-Lab Activity 3.2

Draw the different shapes of epithelial cells.

Simple Squamous	
Simple Cuboidal	
Simple Columnar	

Stratified Squamous	
Stratified Cuboidal	

Pre-Lab Activity 3.3

There are two types of glands: **endocrine** and **exocrine**. Endocrine glands lack a duct system and secrete their product (hormones) directly into the blood stream which diffuses into connective tissues. Exocrine glands secrete their product directly into a duct (or opening; think “lumen”). Exocrine glands can be single cells (goblet cells found in epithelial tissue) or multicellular (made up of cuboidal epithelial cells).

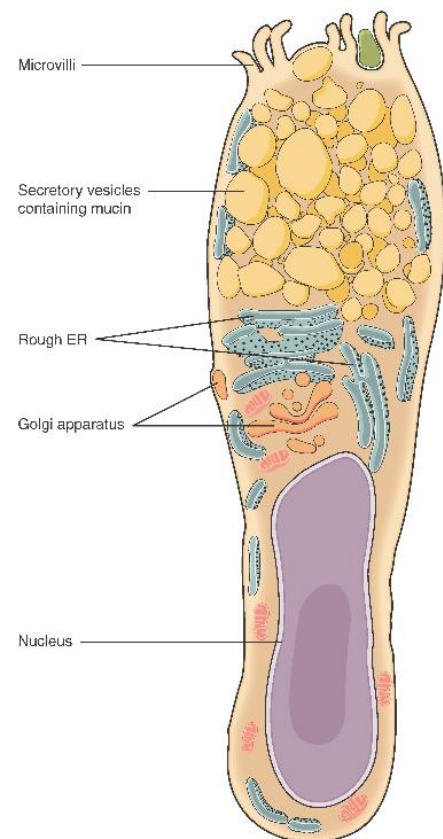
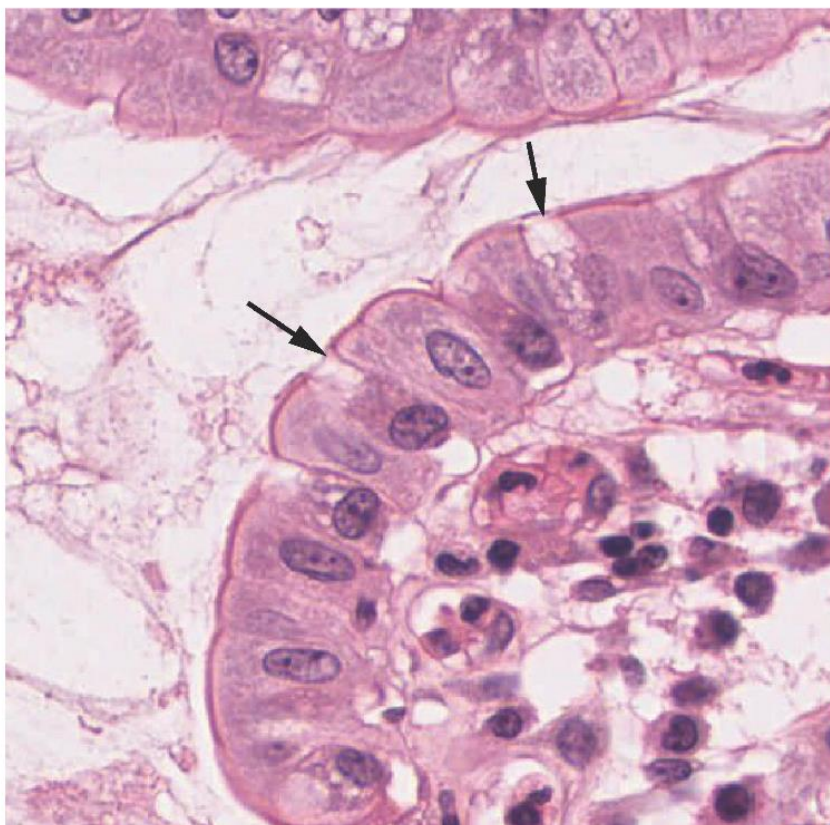
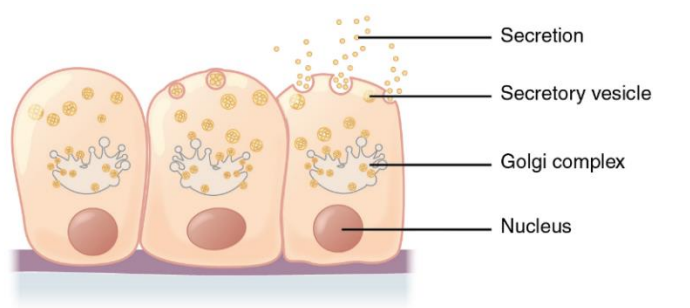


Figure 3.2 Histological image of goblet cells embedded in simple columnar epithelium. These unicellular glands secrete mucous along the surface of the epithelium.

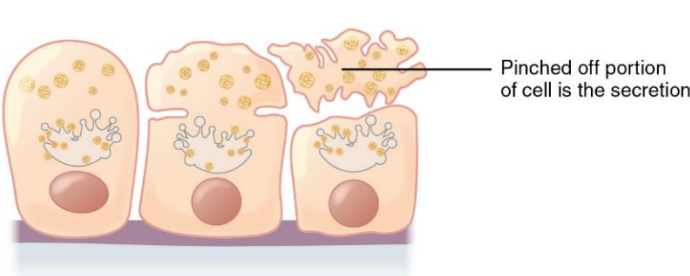
Multicellular exocrine glands include the three types described below:

Merocrine, Apocrine, and Holocrine.

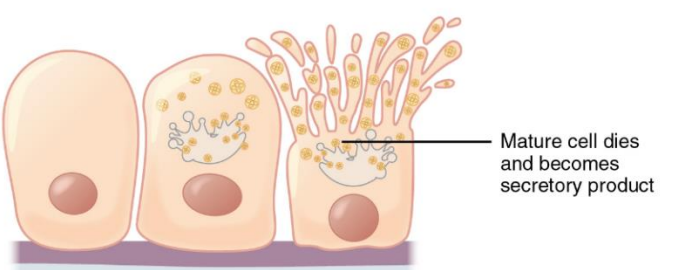
(a) Merocrine secretion



(b) Apocrine secretion



(c) Holocrine secretion



Function

Figure 3.3 Different types of exocrine glands from OpenStax Anatomy and Physiology

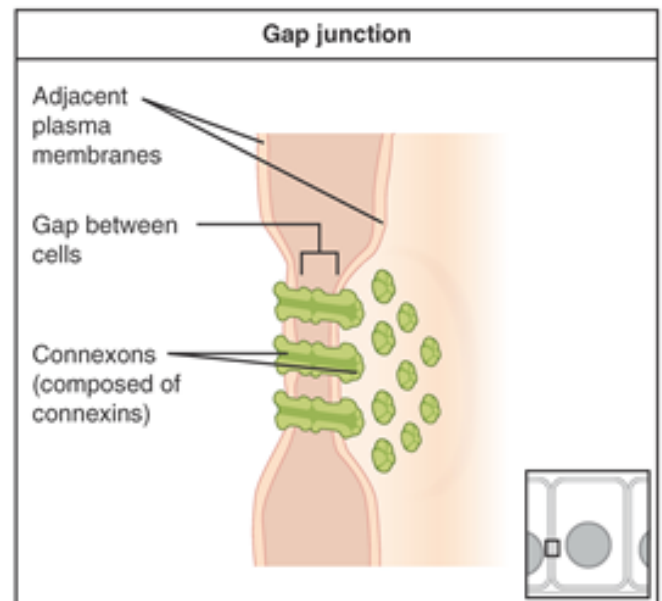
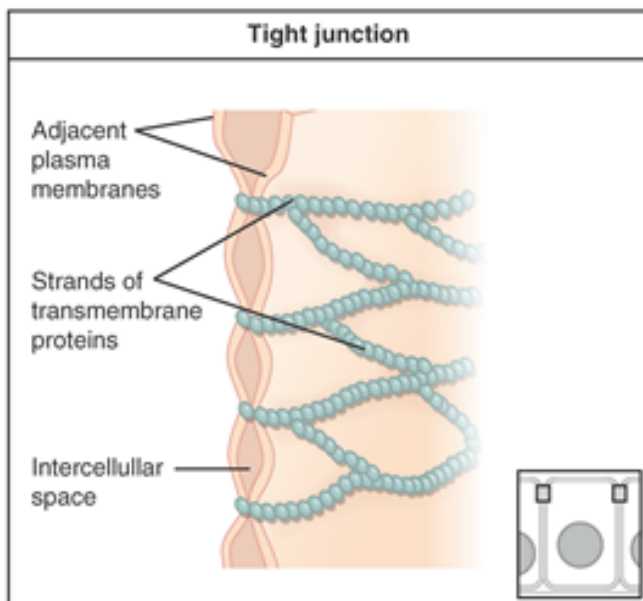
Fill in the following table characterizing glands:

Gland Type		
Endocrine: Deposits product into blood stream by diffusion through connective tissues	Multicellular	Example:

5

Exocrine: deposits product into a lumen/opening/surface	Unicellular	Goblet cell: deposits mucous along intestinal tract; looks like a goblet embedded in columnar epithelial tissue
	Multicellular	Merocrine:
		Example:
		Apocrine: Apex of cell pinches off and secretes product
		Example:
		Holocrine:
		Example: Sebaceous/oil glands in the skin

Pre-Lab Activity 3.4 Types of Cell Junctions



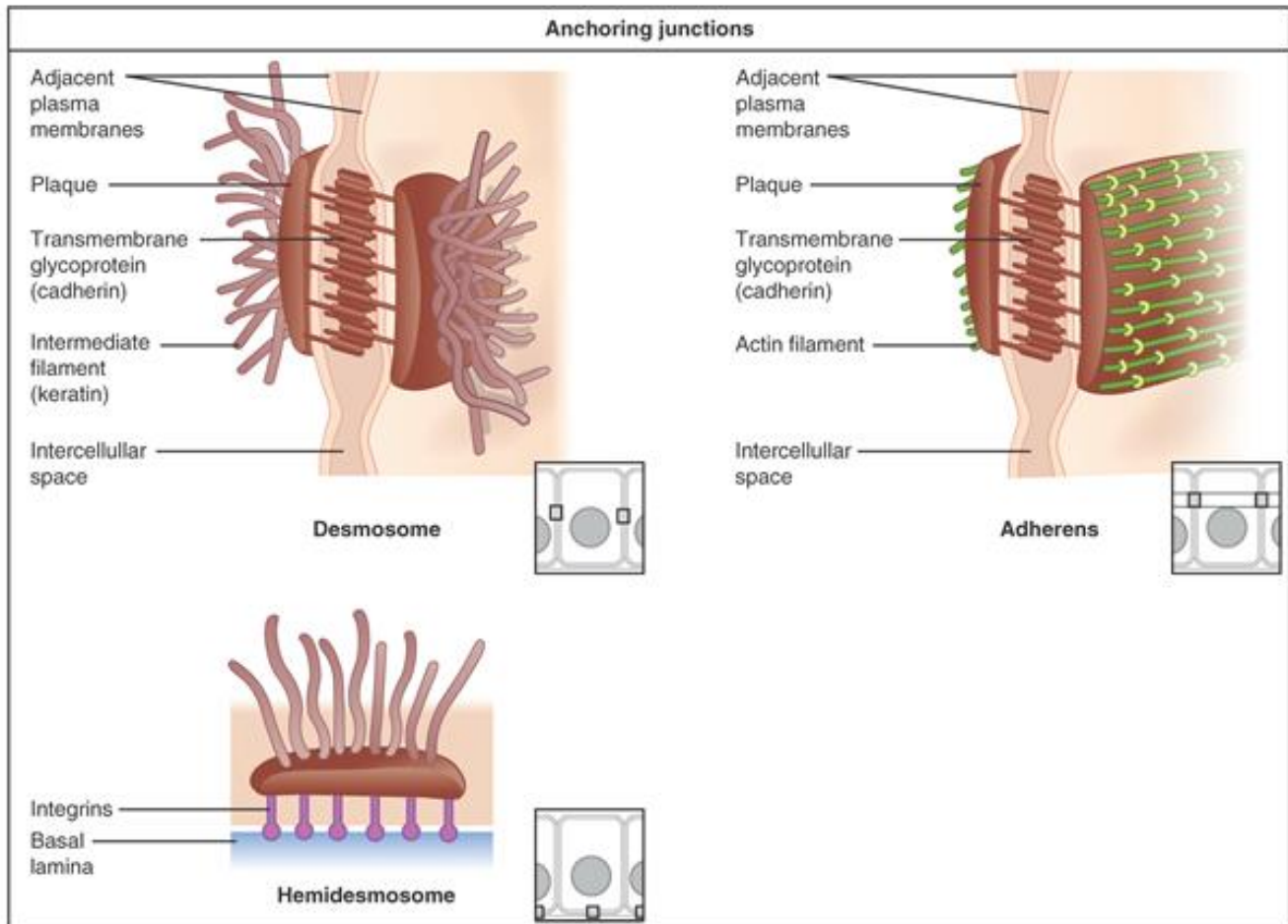


Figure 3.5 Cell to cell junctions; Figure from Openstacks Anatomy and Physiology

Using the descriptions found at <https://cnx.org/contents/FPtK1zmh@12.8:oWqVExrJ@10/Epithelial-Tissue>,

Describe each type of junction & where it can be found in the body in the space below:

Desmosome	
Hemidesmosome	
Tight Junction	
Gap Junctions	
Adherens Junctions	

Exercise 3: Tissues

Activity 3.1: Observation and Description of Epithelial Tissues

Epithelial tissues line surfaces and form glands. There are two primary characteristics of epithelial tissues that should help you with identification: you will find cells close together (no interstitial fluid) and you will see a “**free surface**.” The free surface may be present at a **lumen** or on the surface of the body. The presence of a free surface gives epithelial cells direction: a top and a bottom. The top of the epithelial cell is called the **apical region (free surface)** and the bottom is called the **base (basal surface)**. Because cells in epithelial tissue are in such close contact, they are usually stitched together by cell to cell junctions. Cell to cell junctions come in a few varieties, including desmosomes, tight junctions, and gap junctions. Hemidesmosomes anchor epithelial cells to the **basement membrane**.

Exercise 3.1.1: Fill in the Chart

Using either a slide and microscope, or pictures provided by your instructor, view histological sections of epithelial tissue. Locate the free edge. Notice how cells are adjacent/ contiguous with one another. Draw your observations, labeling the apical region, base, lumen and basement membrane:

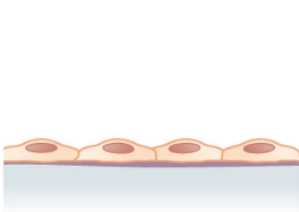
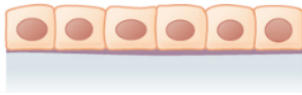
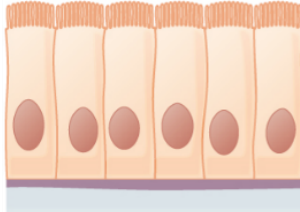
<u>Tissue type and location:</u>	<u>Tissue type and location:</u>
<u>Drawing & Observations</u>	<u>Drawing & Observations</u>

Activity 3.2: Epithelial Tissue Types

Epithelial tissues can be divided into different types based on the shape of the cell and the number of layers present.

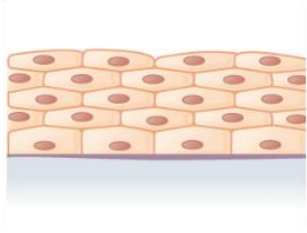
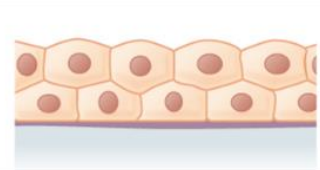
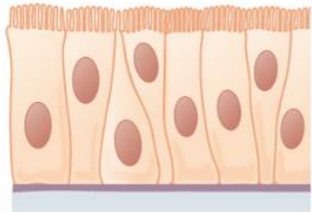
Classification based on shape:

Epithelial cells can be flat, cubical, or cylindrical/rectangular. When epithelial cells appear flattened, they are called “squamous,” when they appear square or cubical, they are called “cuboidal” and when they appear cylindrical or rectangular, they are called “columnar.”

Squamous	Cuboidal	Columnar
		

Classification based on layer:

Epithelial tissues can be made of a single layer of cells (simple) or multiple layers of cells (stratified). Pseudostratified appears at first glance to be multilayered, but is not. Some of the cells in pseudostratified do not reach the apical surface and the cell nuclei are not uniformly distributed giving it a “pseudo” (fake; false) layered appearance.

Stratified (squamous)	Stratified (cuboidal)	Pseudostratified (columnar)
		

Activity 3.3: Identifying Epithelial Tissue Types

Use the following chart to identify the “unknown” tissue types in the exercise below.

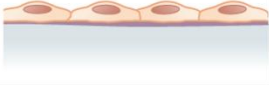
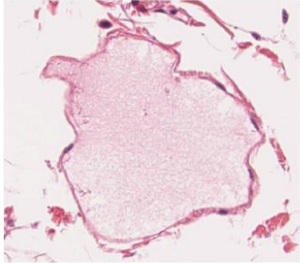
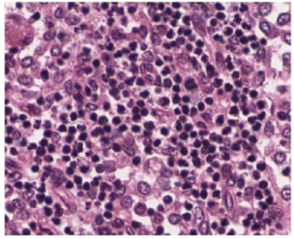
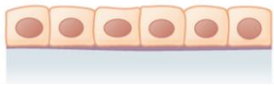
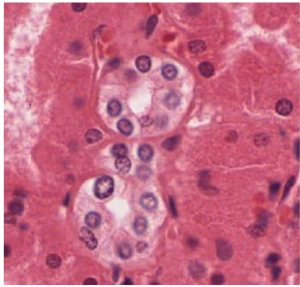
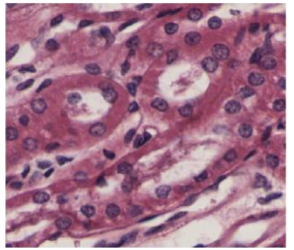
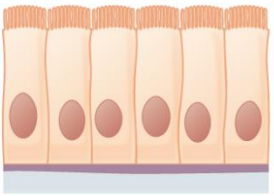
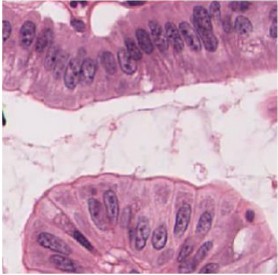
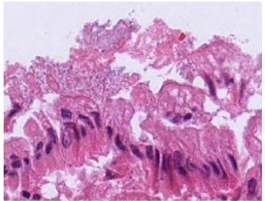
Epithelial Tissue Type Description	Drawing of Type	Example 1	Example 2
<p><i>Simple Squamous:</i></p> <p>Single layer of cells appear flattened</p> <p>Found lining blood vessels (endothelium), and makes up mesentery</p>		<p>Example: Endothelium</p> 	<p>Example: Mesentery</p> 
<p><i>Simple Cuboidal:</i></p> <p>Single layer of cells appear square or cube shaped</p> <p>Found lining glands</p>		<p>Example: Kidney</p> 	<p>Example: Kidney</p> 
<p><i>Simple Columnar:</i></p> <p>Single layer of cells appear rectangular or cylindrical</p> <p>Found in the gut- lining the small intestine and colon</p>		<p>Example: Small Intestine</p> 	<p>Example: Colon</p> 

Figure 3.3.1: Micrographs provided by the Regents of University of Michigan Medical School © 2012

Exercise 3.2.1: Identify the tissues Your instructor will provide you with images of connective tissue to complete the activity below.

Identification of Simple Epithelial Tissue:

Microscope/Image A: _____

Microscope/Image B: _____

Microscope/Image C: _____

Microscope/Image D: _____

Microscope/Image E: _____

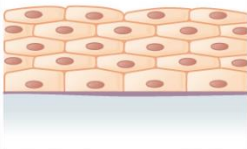
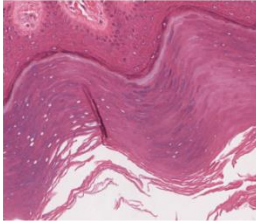
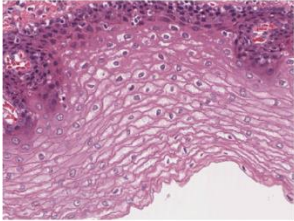
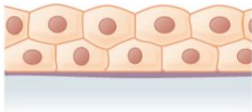
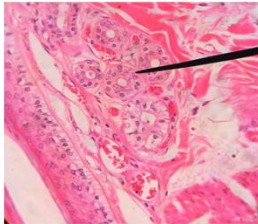
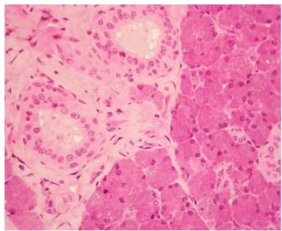
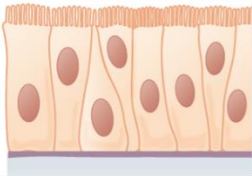
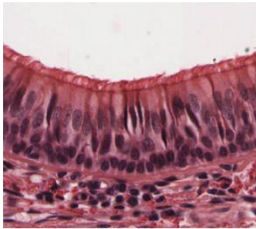
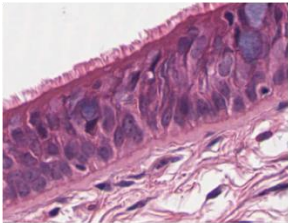
Epithelial Type Description	Drawing of Type	Example 1	Example 2
Stratified Squamous: Multiple layer of cells appear flattened Found lining the mucosa of the body and making up the top layer of skin (epidermis); found in places that need to resist abrasion		Example: Epidermis 	Example: Esophagus 
Stratified Cuboidal: Double layer of cells appear square or cube shaped Found lining glands		Example: Sweat Gland 	Example: Parotid Gland 
Pseudostratified Columnar: Single layer of cells appear as a double layer of rectangular or cylindrical cells;		Example: Trachea 	Example: Trachea 

Figure 3.3.2: Micrographs provided by the Regents of University of Michigan Medical School © 2012

Exercise 3.1.2: Identify the tissues Your instructor will provide you with images of epithelial to complete the activity below.

Identification of Stratified/ Pseudostratified Epithelial Tissue:

Microscope/Image F: _____

Microscope/Image J: _____

Microscope/Image G: _____

Microscope/Image K: _____

Microscope/Image H: _____

Microscope/Image L: _____

Microscope/Image I: _____

Activity 3.4: Identification of Connective Tissue Types

Connective Tissues differ from epithelial tissues in two primary ways: cells are spaced far apart, and cells are separated by an extracellular matrix. The **extracellular matrix** (region of material outside of the cells) is also called the interstitial space. The cells in connective tissue build this matrix, which is made up of non-living material (water, minerals, etc) and different types of proteins. The specific composition of this extracellular matrix and the type of cells in the tissue define the type of connective tissue. The matrix and cells differ based on the function of the tissue. For example, some connective tissues have more elastin protein in their extracellular matrix. This makes them more elastic. The property of being elastic allows the tissue to return to its original shape after being stretched.

Can you think of an area of the body where you would find more elastic connective tissue?
(hint: dilates and constricts to accommodate increase/ decrease in blood flow)

Connective Tissue can be divided into different categories. The following divisions can be used to categorize connective tissue:

Connective tissue proper	Categories	Types	Cells/ Extracellular Matrix/ Appearance
	Loose connective tissue	<ul style="list-style-type: none">• Areolar• Adipose• Reticular	Fibroblasts/
			Adipocytes/
			Fibroblasts/ high concentration of reticular fibers
	Dense connective tissue	<ul style="list-style-type: none">• Regular elastic• Irregular elastic	Fibroblasts/ collagen and elastin fiber in parallel organization
			Fibroblasts/ collagen and elastin fiber in haphazard organization
Supportive connective tissue	Cartilage	<ul style="list-style-type: none">• Hyaline• Fibrocartilage• Elastic	Chondrocytes

	Bones	• Cortical/ Compact Bone	Osteoblasts/ osteocytes/ mineral embedded in collagen/ made up of osteons, or cylindrical layers of mineral surrounding a blood vessel.
		Trabecular/ Cancellous	Osteoblasts/ osteocytes/ mineral embedded in collagen; looks like a sponge, contains spicules or “struts”
Fluid connective tissue	Lymph		Interstitial fluid with leukocytes
	Blood		Erythrocytes, platelets, white blood cells/ ECM is plasma/ large number of red blood cells in fluid, white blood cells and platelets not as prolific, but spread throughout

Exercise 3.4.1: Identify the tissues Your instructor will provide you with images of connective tissue to complete the activity.

Identification of Connective Tissues:

Microscope/Image M: _____

Microscope/Image P: _____

Microscope/Image N: _____

Microscope/Image Q: _____

Microscope/Image O: _____

Microscope/Image R: _____

Sketch & Label one of the specific types of connective tissue below. List its unique identifying features and where it is typically found in the human body.

Additional Types of Connective Tissue:

Bone is an interesting type of connective tissue, because the extracellular matrix is composed of a hard mineral, called **hydroxyapatite**. The hydroxyapatite is embedded in bands of collagen and elastin. All three components help bone remain somewhat hard and rigid for muscle attachments and support, but also strong and flexible so that it does not break under force.

Blood is also an interesting type of connective tissue, because its extracellular matrix is liquid.

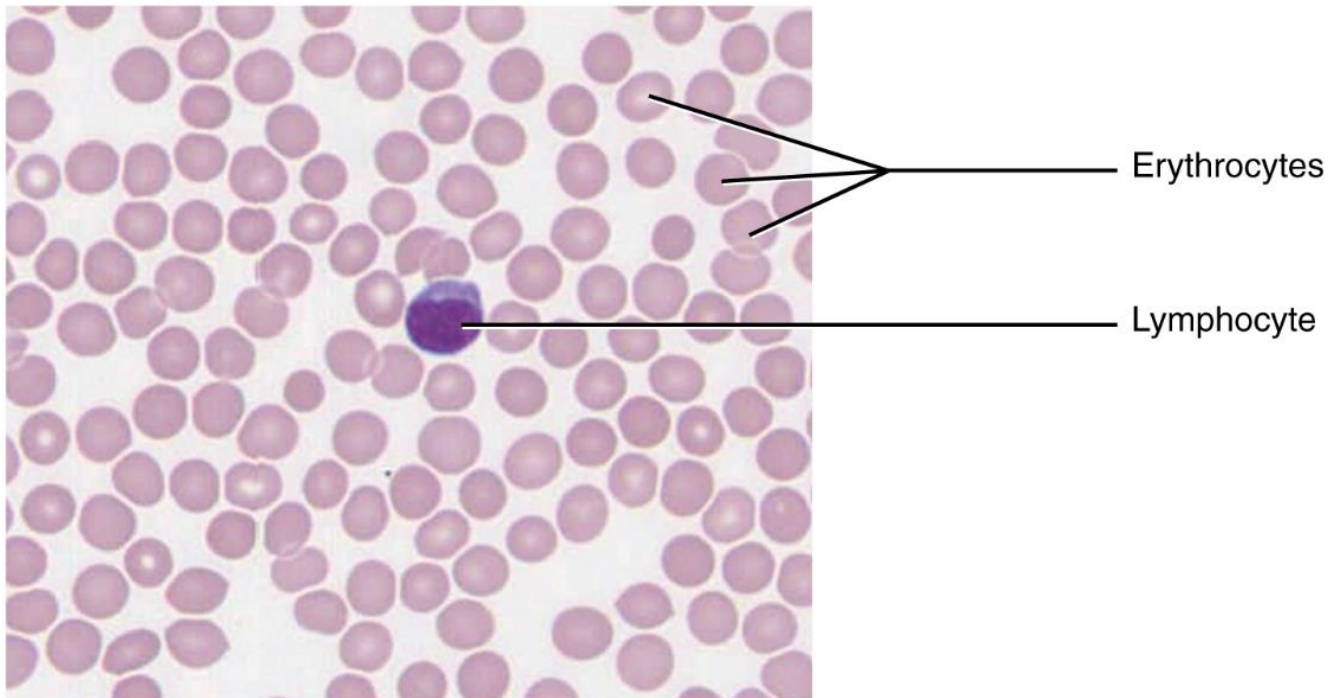
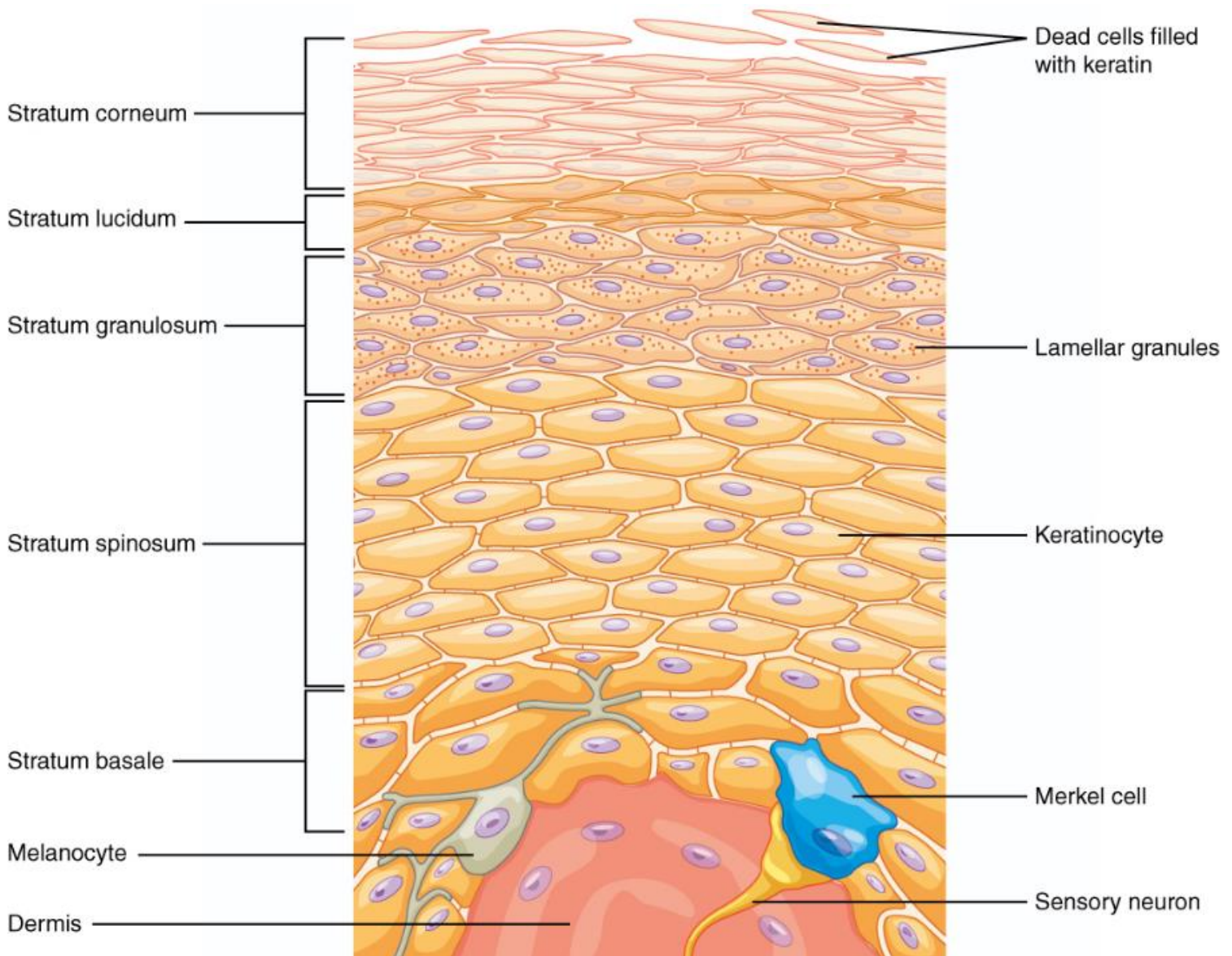


Figure 3.4.1: Micrograph provided by the Regents of University of Michigan Medical School © 2012

Exercise 3.4.2 Critical Thinking Relate the structure of the extracellular matrix of bone and blood to how each tissue functions in the human body.

Activity 3.5: The Skin

The skin is composed of an **epidermis** which is made up of several layers of stratified squamous and simple cuboidal epithelial tissue and the **dermis**, which is made up of two layers of connective tissue: a **papillary layer** and a **reticular layer**. In the image below, note the 5 layers of epithelial tissue from superficial to deep: stratum corneum, stratum lucidum (found only in the thick skin of palms and soles), the stratum granulosum, the stratum spinosum, and the stratum basale. In the table below, describe the appearance, features, and general function of each layer.



Exercise 3.5.1 Fill in the chart below

You may use your textbook or Google to learn about the layers of the epidermis.

Epidermal Layer	Appearance	Features	General Function
Stratum corneum			
Stratum lucidum			
Stratum granulosum			
Stratum spinosum			
Stratum basale			

Exercise 3.5.2 Observe and Label the histological images of the skin. Identify each layer.

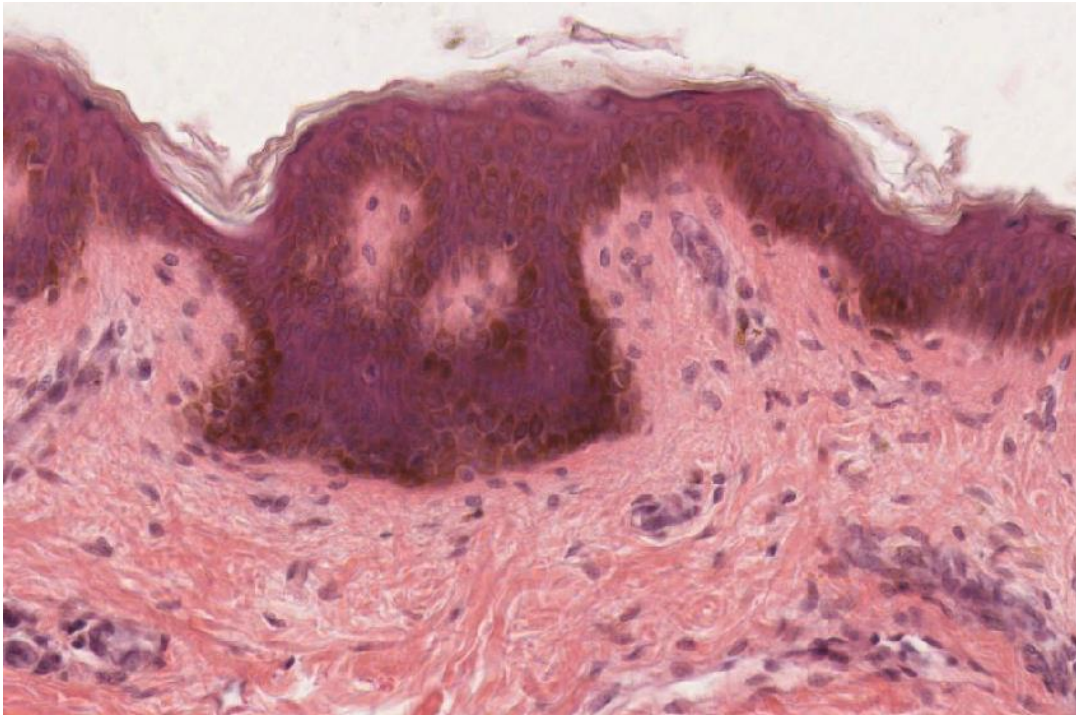


Figure 3.5.1: Thin Skin; Micrograph provided by the Regents of University of Michigan Medical School
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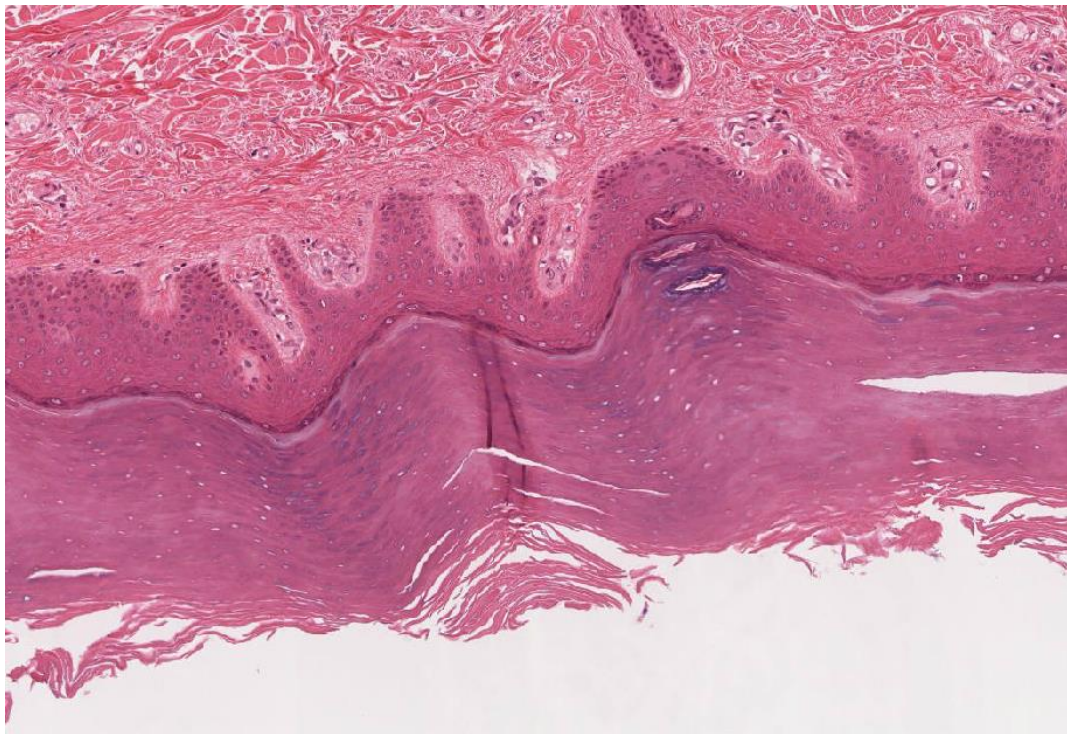


Figure 3.5.2: Thick Skin; Micrographs provided by the Regents of University of Michigan Medical School
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Activity 3.6: Observation of Muscle Tissue

Muscle tissue is composed of muscle fibers, or cells. There are three types of muscle tissue that will be covered in this lab: skeletal muscle tissue, smooth muscle tissue, and cardiac muscle tissue. Each type has specific characteristics that will be focused on in the muscle tissue lab.

Drawing of Muscle Tissue	Description of Muscle Tissue (types of cell, interstitial space, shape of cells)
<u>Skeletal</u>	
<u>Cardiac</u>	
<u>Smooth</u>	

Activity 3.7: Observation and Description of Neural Tissue

Neural Tissue is composed of neurons and support cells calls neuroglia. Observe the histology of neural tissue (from microscope of image provided by your instructor). Draw and describe what you see.

Drawing of Neural Tissue	Description of Neural Tissue (types of cell, interstitial space, shape of cells)

Post-Exercise 3 Review Questions

Answer the following questions:

1. List the 4 types of tissues.

2. Describe the characteristics of epithelial tissues (cell spacing, etc) and connective tissues.

3. Which type of gland deposits its secretory products into the blood stream by diffusion?

- a. Endocrine
- b. Exocrine
- c. Apocrine
- d. Merocrine

4. In which gland type does the whole mature cell die and become the secretion?

- a. Merocrine
- b. Endocrine
- c. Apocrine
- d. Holocrine

5. A unicellular gland that produces mucous on the surface of an epithelial tissue is called a _____ cell.

- a. Goblet
- b. Columnar
- c. Squamous
- d. Cuboidal

6. Which of the following does not fall under the category of connective tissue proper?
- Adipose
 - Dense regular
 - Hyaline cartilage
 - Reticular
7. What type of cell is associated with connective tissue proper?
- Chondrocyte
 - Osteoblast
 - Fibroblast
 - Erythrocytes
8. Which of the following protein fibers is found in a high quantity in dense regular and dense irregular connective tissue?
- Reticular
 - Collagen
 - Elastin
 - Troponin
9. You peer into a microscope to observe rectangular cells with purple nuclei situated closely together, with little to no space between them. You also observe an open space or lumen on their apical surface. What type of tissue are you looking at?
- Simple squamous
 - Simple columnar
 - Simple cuboidal
 - Dense regular connective tissue
10. What type of tissue is the epidermis of the skin?
- Simple squamous
 - Simple cuboidal
 - Stratified squamous
 - Connective tissue proper

11. Where would you expect to find simple cuboidal cells?
- a. Lining the colon
 - b. In the kidney
 - c. Lining the esophagus
 - d. Making up the mesentery
12. Where would you expect to find elastic cartilage?
- a. In the nose and earlobe
 - b. Between the bones of the pubic symphysis, where little to no movement occurs
 - c. Between vertebral discs
 - d. At the ends of the long bones, such as the femur or the humerus
13. Which layer of the epidermis is composed of simple cuboidal cells that act as a germ layer, producing layers of squamous epithelium above?
- a. Stratum spinosum
 - b. Stratum lucidum
 - c. Stratum corneum
 - d. Stratum basale
14. Which type of muscle is characterized by long cylindrical fibers (cells) that have striations?
- a. Cardiac
 - b. Smooth
 - c. Skeletal
 - d. Rough
15. Bone tissue differs from other types of connective tissue because _____.
- a. It has a high amount of cartilage in its extracellular matrix
 - b. It has a high amount of collagen in its extracellular matrix
 - c. It has a high amount of mineral (hydroxy apatite) in its extracellular matrix
 - d. It has more fibroblasts embedded in its extracellular matrix