What to Know

• What is a tissue? Organ? Organ system?
• What are the 4 main types of tissue?
• What do these tissues look like, how do they function and where are they found?
• What is the integumentary system?
• How can you prevent skin cancer?
• What is homeostasis and how is it maintained?
Body Organization and Homeostasis

- The organization of the human body increases in complexity from cells to organ systems
- Homeostasis is a state of relative internal constancy
Organization of the Human Body

- Multicellular organisms require specialized cells to perform specific tasks
- These cells then organize into tissues, organs and organ systems
- The skin is an organ system
What is a tissue?

- **Definition:** is a group of cells that work together to accomplish a common function

- **There are 4 major tissue types in the body:**
  1. **Epithelial** - covers the body surfaces, lines cavities and organs, and forms glands
  2. **Connective** - serves as a storage site for fat, participates in our immunity, and provides support and protection for our organs
  3. **Muscular** - moves the body / parts
  4. **Nervous** - receives stimuli and conducts nerve impulses to coordinate body activities
1. Epithelial tissue

- All epithelial tissues share two characteristics
  1. A free surface that may be specialized for protection, secretion, or absorption
  2. A basement membrane which binds the epithelial cells to underlying connective tissue and helps the epithelial tissue resist stretching

- A group of cells that form a tight, continuous network
- Lines body cavities, covers body surfaces and found in glands
- Named after the appearance of cell layers and the shape of the cells
How do we name epithelial tissue?

- **Number** of cell layers:
  - **Simple**: one layer of cells
  - **Stratified**: more than one layer of cells
  - **Pseudostratified**: appears to have layers but only has one layer

- **Shape** of cell:
  - **Cuboidal**: cube-shaped
  - **Columnar**: column-shaped
  - **Squamous**: flattened

**There is transitional epithelium that changes in appearance in response to tension—found in the urinary bladder**
• **Squamous epithelium** is made of flattened cells—”squished”
  – This shape allows for diffusion of materials, and can provide a slick surface to reduce friction
Simple squamous

- One layer of flattened cells
- Located in air sacs of lungs, heart and blood vessel linings
- Allows exchange of nutrients, gases, and wastes
STRATIFIED SQUAMOUS EPITHELIUM

Stratified squamous

- Several layers of flattened cells
- Located on surface of skin, lining of mouth, esophagus, and vagina
- Provides protection against abrasion, infection, and drying out
Cuboidal epithelium, not surprisingly, is made of cube-shaped cells

- Specialized for secretion and absorption
**Simple cuboidal epithelium**

- One layer of cube-shaped cells
- Located in linings of kidney tubules and glands
- Functions in absorption and secretion
Stratified cuboidal
- Usually two layers of cube-shaped cells
- Located in ducts of mammary glands, sweat glands, and salivary glands
- Functions in protection
Organization of the Human Body

• **Columnar epithelium** is tall and rectangular
  – Specialized for secretion-mucus and enzymes and absorption
  – Lines the small & large intestine & respiratory tract-bronchi, uterus
  – Urethra-stratified
**Simple Columnar Epithelium**

*Simple columnar*
- One layer of tall, slender cells
- Located in lining of gut and respiratory tract
- Functions in absorption and secretion
STRATIFIED COLUMNAR EPITHELUM

**Stratified columnar**
- Several layers of tall, slender cells
- Rare, located in urethra (tube through which urine leaves the body)
- Functions in protection and secretion
<table>
<thead>
<tr>
<th>Shape</th>
<th>Number of Layers</th>
<th>Example Locations</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Squamous (flat, scale-like cells)</td>
<td>Simple (single layer)</td>
<td>Lining of heart and blood vessels, air sacs of lungs</td>
<td>Allows passage of materials by diffusion</td>
</tr>
<tr>
<td></td>
<td>Stratified (more than one layer)</td>
<td>Linings of mouth, esophagus, and vagina; outer layer of skin</td>
<td>Protects underlying areas</td>
</tr>
<tr>
<td>Cuboidal (cube-shaped cells)</td>
<td>Simple</td>
<td>Kidney tubules, secretory portion of glands and their ducts</td>
<td>Secretes; absorbs</td>
</tr>
<tr>
<td></td>
<td>Stratified</td>
<td>Ducts of sweat glands, mammary glands, and salivary glands</td>
<td>Protects underlying areas</td>
</tr>
<tr>
<td>Columnar</td>
<td>Simple</td>
<td>Most of digestive tract (stomach to anus), air tubes of lungs (bronchi), excretory ducts of some glands, uterus</td>
<td>Absorbs; secretes mucus, enzymes, and other substances</td>
</tr>
<tr>
<td></td>
<td>Stratified</td>
<td>Rare; urethra, junction of esophagus and stomach</td>
<td>Protects underlying areas, secretes</td>
</tr>
</tbody>
</table>
Simple squamous
- lining of lungs, blood vessels
- protects

Simple cuboidal
- lining of kidney tubules, various glands
- absorbs molecules

Simple columnar
- lining of small intestine, oviducts
- absorbs nutrients

Pseudostratified, ciliated columnar
- lining of trachea
- sweeps impurities toward throat

Stratified squamous
- lining of nose, mouth, esophagus, anal canal, vagina
- protects

basement membrane

goblet cell secretes mucus

basiement membrane

cilia

goblet cell secretes mucus

basement membrane
Organization of the Human Body

• Glands are composed of epithelial tissue
• Exocrine glands secrete their products into ducts
• Endocrine glands secrete their products directly into blood
2. Connective tissue

- Connective tissue is the most abundant and widely distributed tissue in the body. It is the body’s “glue.”
- Connective tissue consists of:
  1. Connective tissue proper - loose and dense
  2. Specialized connective tissues - cartilage, bone, blood and lymph
2. Connective tissue

- Binds and supports parts of the body - are diverse in structure and function yet they all have.....

1. specialized cells
2. ground substance - is acellular & separates the cells; it ranges from solid to fluid
3. protein fibers - collagen, reticular, elastic
   - protein fibers are produced by fibroblasts, which are also responsible for tissue repair

- The ground substance and proteins fibers together make up the matrix of the tissue
3 main types of connective tissue

1. Fibrous or Proper
2. Supportive
3. Fluid
Connective Tissue Proper
or
Fibrous CT
2 names same thing

- 2 basic types:
  1. Loose connective tissue
  2. Dense connective tissue

   - The tissues differ in the ratio of cells to extracellular fibers.
1. Loose fibrous connective tissue (areolar)

- Contains many cells and fewer, loosely woven fibers
- Used to cushion organs and to provide insulation – the packing material
  - Supports epithelium and many internal organs
  - Lungs, arteries, bladder-expansion; also covers muscles, blood vessels and nerves
  - Adipose tissue is a special **loose** fibrous tissue where fat is stored - body uses fat for energy, insulation, organ protection
What does loose fibrous connective tissue look like?
AREOLAR or LOOSE CONNECTIVE TISSUE PROPER

**Areolar connective tissue**
- Widely distributed; found under skin, around organs, between muscles
- Wraps and cushions organs
Adipose (fat) tissue
- Found under skin, around kidneys and heart
- Functions in energy storage and insulation; cushioning for organs
2. Dense Fibrous Connective Tissue

- Dense fibrous connective tissue- many collagen fibers that are packed together
- Function is more specific than loose connective tissue= tendons, ligaments and dermis
- TENDONS-muscles to bone
- LIGAMENTS-bones to bones
Dense connective tissue

- Found in tendons and ligaments
- Forms strong bands that attach bone to muscle or bone to bone
Specialized Connective Tissue

2. **Supportive**
   a. Cartilage
   b. Bone

3. **Fluid**
   a. Blood
   b. Lymph
a. Cartilage

- **Cartilage** is tough but flexible, and serves as a cushion between bones
  - Cells are in chambers called lacunae
  - Lack of blood vessels and nerves results in cartilage healing more slowly than bone
- **Hyaline**, **elastic**, and **fibrocartilage** are three types of cartilage they differ in flexibility and location
a. Cartilage

• Hyaline cartilage
  ❖ Most abundant; provides support and flexibility; has fine collagen fibers
    Location: Nose, ends of long bones and fetal skeleton

• Elastic Cartilage
  ❖ More flexible; contains elastic fibers
    Location: Outer ear

• Fibrocartilage
  ❖ Has the fewest cells; made to withstand pressure
    Location: Disks between vertebrae, menisci of knees
**Cartilage**

- Found in rings of respiratory air tubes, external ear, tip of nose
- Provides flexible support; cushions
b. Supportive connective tissue: Bone

- Cells are in chambers called lacunae
- Matrix is solid and rigid that is made of collagen and calcium salts
- 2 types are distinguished by types of fibers
  1. **Compact** – made of repeating circular units called osteons which contain the hard matrix and living cells and blood vessels. Location: Shafts of long bone
  2. **Spongy** – an open, latticework with irregular spaces. Location: Ends of long bones- solid portions along stress lines
Bone

- Found in the skeleton
- Functions in support, protection (by enclosing organs), and movement
What do bone and cartilage look like?
Bone Types

- spongy bone
- compact bone
- medullary (marrow) cavity
- epiphysis
  - head
- diaphysis
  - shaft
- cancellous
- compact
3. Fluid Connective Tissues
Blood and Lymph

a. Blood

1. Made of a fluid matrix called plasma and cellular components that are called formed elements (RBC, WBC, Platelets)
2. Transports nutrients and $O_2$ to cells and removes $CO_2$ and wastes
3. Blood transports heat, has a role in fluid, ion and pH balance
4. Body systems keep blood composition and chemistry WNL
Blood

- **3 formed elements**: have specific functions
  1. **Red blood cells** – cells that carry oxygen-hemoglobin, heme
  2. **White blood cells** – (leukocytes) cells that fight infection
  3. **Platelets** – (thrombocytes) pieces of giant cells in b.marrow that clot blood
Blood Cells
b. Fluid connective tissue: Lymph

• Matrix is a fluid called lymph
• White blood cells congregate in this tissue
• Absorbs fat
3. Muscle Tissue

- Allows for movement in the body
- Made of muscle fibers/cells and protein fibers called actin and myosin
- There are 3 types of muscle tissue in humans:
  A. Skeletal
  B. Smooth
  C. Cardiac
A. Skeletal Muscle

- Appearance: long, cylindrical cells, multiple nuclei, striated fibers
- Location: attached to bone for movement
- Nature: voluntary movement
B. Smooth Muscle

Appearance: spindle-shaped cell with one nucleus, lack striations

Location: walls of hollow organs and vessels

Nature: involuntary movement
C. Cardiac Muscle

Appearance: branched cells with a single nucleus, striations with darker striations called intercalated disks between cells.

Location: heart

Nature: involuntary movement
4. Nervous tissue

- Allows for communication between cells through sensory input, integration of data and motor output

- Made of 2 major cell types:
  A. Neurons
  B. Neuroglia
A. Nervous tissue - neurons

- Made of dendrites, a cell body and an axon
- **Dendrites** carry information **toward** the cell body
- **Axons** carry information **away** from the cell body
A. Nervous tissue - neuroglia

- A collection of cells that support and nourish neurons
- Outnumber neurons 9:1
- Examples are oligodendrocytes, astrocytes and microglia
How are cells connected within a tissue?

- **Tight junctions** – proteins join and form an impermeable barrier between plasma membranes in a zipper-like fashion

- **Adhesion junctions** – cytoskeletal fibers join between cells and have flexibility

- **Gap junctions** – a fusion of adjacent plasma membranes with small channels between them that allow small molecules to diffuse
(a) **Tight junction**

- Creates an impermeable junction that prevents the exchange of materials between cells
- Found between epithelial cells of the digestive tract, where they prevent digestive enzymes and microorganisms from entering the blood
(b) Adhesion junction

- Holds cells together despite stretching
- Found in tissues that are often stretched, such as the skin and the opening of the uterus

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(c) Gap junction
- Allows cells to communicate by allowing small molecules and ions to pass from cell to cell
- Found in epithelia in which the movement of ions coordinates functions, such as the beating of cilia; found in excitable tissue such as heart and smooth muscle
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Moving from tissue to organs and organ systems

- An organ is 2 or more tissue types working towards a particular function

- An organ system is a combination of organs that work together to carry out a particular function
The integumentary system:

• Includes the skin and accessory organs such as hair, nails and gland

• The skin has two main regions called the epidermis and the dermis

• Under the skin there is a subcutaneous layer between the dermis and internal structures where fat is stored

• Is important for maintaining homeostasis
What are the functions of the integumentary system

1. Protects the body from physical trauma, invasion by pathogens and water loss

2. Helps regulate body temperature

3. Allows us to be aware of our surroundings through sensory receptors

4. Synthesizes chemicals such as melanin and vitamin D
There are two regions of the skin

- Epidermis
- Dermis
The Epidermis

- The thin, outermost layer of the skin
- Made of epithelial tissue
- Cells in the uppermost cells are dead and become filled with keratin thus acting as a waterproof barrier
- Langerhans cells are a type of white blood cell that help fight pathogens
- Melanocytes produce melanin that lend to skin color and protection for UV light
- Some cells convert cholesterol to vitamin D
The Dermis

- The thick, inner layer of the skin
- Made of dense fibrous connective tissue
- Contains elastic and collagen fibers
- Contains blood vessels, many sensory receptors and glands
What are the accessory organs of the skin and why are they important?

- Includes nails, hair and glands
- Nails are derived from the epidermis that offer a protective covering
- Hair follicles are derived from the dermis but hair grows from epidermal cells
- Oil glands are associated with hair and produce sebum that lubricates hair and skin as well as retards bacterial growth
- Sweat glands are derived from the dermis and helps to regulate body temperature
What you need to know about skin cancer?

- 2 of the 3 types that arise in the epidermis:
  - Basal cell carcinoma is the most common yet least deadly form of skin cancer
  - Melanoma is the most deadly form of skin cancer but is the least common

- What can you do to help prevent this?
  - Stay out of the sun between 10am-3pm
  - Wear protective clothing (tight weave, treated sunglasses, wide-brimmed hat)
  - Use sunscreen with an SPF of at least 15 and protects from UV-A and UV-B rays
  - Don’t use tanning beds
What might skin cancer look like?
What are the body cavities?

Cranial cavity: contains brain
Vertebral cavity: contains spinal cord
Thoracic cavity: contains heart, lungs, and esophagus
Abdominal cavity: contains stomach, liver, spleen, pancreas, gallbladder, and intestines
Pelvic cavity: contains reproductive and other organs

Thoracic cavity: contains esophagus, heart, and lungs
Abdominal cavity: contains digestive and other organs
Pelvic cavity: contains reproductive and other organs
Body Cavities

- Thoracic cavity
  - Pleural cavity contains a lung
  - Pericardial cavity contains heart
  - Ventral cavity
    - Thoracic cavity
    - Diaphragm
    - Abdominal cavity
What about the body membranes that line the cavities?

- Mucous membranes – lining of the digestive, respiratory, urinary and reproductive systems

- Serous membranes – line lungs, heart, abdominal cavity and covers the internal organs; named after their location
  - Pleura: lungs
  - Peritoneum: abdominal cavity and organs
  - Pericardium: heart

- Synovial membranes – lines the cavities of freely movable joints

- Meninges – cover the brain and spinal cord
What are the organ systems of the human body?

- **Integumentary system**: protects body, receives sensory input, helps control temperature, synthesizes vitamin D.

- **Cardiovascular system**: transports blood, nutrients, gases, and wastes, helps control fluid balance, absorbs fats, defends against disease, helps control temperature, fluid, and pH balance.

- **Lymphatic and immune systems**: helps control fluid balance, absorbs fats, defends against disease, helps control infectious disease.

- **Digestive system**: ingests food, digests food, absorbs nutrients, eliminates waste.

- **Respiratory system**: maintains breathing, exchanges gases at lungs and tissues, helps control pH balance.

- **Urinary system**: excretes metabolic wastes, helps control fluid balance, helps control pH balance.
What are the organ systems of the human body?

- **Skeletal system**: supports the body, protects body parts, helps move body, stores minerals, produces blood cells.
- **Muscular system**: maintains posture, moves body and internal organs, produces heat.
- **Nervous system**: receives sensory input, integrates and stores input, initiates motor output, helps coordinate organ systems.
- **Endocrine system**: produces hormones, helps coordinate organ systems, responds to stress, helps regulate fluid and pH balance, helps regulate metabolism.
- **Reproductive system**: produces gametes, transports gametes, produces sex hormones, nurtures and gives birth to offspring in females.
What is homeostasis?

• The ability to maintain a relatively constant internal environment in the body

• The nervous and endocrine systems are key in maintaining homeostasis

• Changes from the normal tolerance limits results in illness or even death
All systems are important in maintaining homeostasis.
What are the mechanisms for maintaining homeostasis?

- Negative feedback
- Positive feedback
Negative feedback

• The primary mechanism for maintaining homeostasis

• Has two components:
  • sensor
  • control center

• The output of the system dampens the original stimulus
An example of negative feedback: body temperature
Positive feedback

• A mechanism for increasing the change of the internal environment in one direction

• An example is the secretion of oxytocin during birth to continually increase uterine contractions

• Can be harmful such as when a fever is too high and continues to rise