Chapter 04
Lecture Outline

See separate PowerPoint slides for all figures and tables pre-inserted into PowerPoint without notes.
Organization and Regulation of Body Systems
Points to ponder

- 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?
What is a tissue?

- A collection of cells of the same type that perform a common function

- There are 4 major tissue types in the body.
  1. Connective
  2. Muscular
  3. Nervous
  4. Epithelial
1. Connective tissue

- It binds and supports parts of the body.
- It has specialized cells, ground substance, and protein fibers.
- Ground substance is noncellular and ranges from solid to fluid.
- Ground substance and protein fibers together make up the matrix of the tissue.
- There are 3 main types of connective tissue: A. fibrous, B. supportive, and C. fluid.
3 main types of connective tissue

A. Fibrous
B. Supportive
C. Fluid

Figure 4.4 Types of connective tissue.
A. Fibrous connective tissue

• There are 2 types: dense and loose, but both contain fibroblast cells with a matrix of collagen and elastic fibers.

• Loose fibrous tissue is found supporting epithelium and many internal organs.

• Adipose tissue is a special, loose fibrous tissue where fat is stored.
What does loose fibrous connective tissue look like?

- Elastic fiber: branched and stretchable
- Collagen fiber: unbranched, strong but flexible
- Fibroblast: divides to produce other types of cells
- Reticular fiber: branched, thin, and forms network
- White blood cell: engulfs pathogens or produces antibodies
- Adipose cell: stores fat
- Ground substance: fills spaces between cells and fibers
- Blood vessel

Figures 4.1 and 4.2 Connective tissues (components and knee).
B. Supportive connective tissue: Cartilage

- Cells are in chambers called lacunae.
- Matrix is solid but flexible.
B. Supportive connective tissue: Cartilage

- 3 types are distinguished by types of fibers.
  1. **Hyaline cartilage** – fine collagen fibers
     Location: Nose, ends of long bones, and fetal skeleton
  2. **Elastic cartilage** – more elastic fibers than cartilage fibers
     Location: Outer ear
  3. **Fibrocartilage** – strong collagen fibers
     Location: Disks between vertebrae
B. Supportive connective tissue: Bone

- Cells are in chambers called lacunae.
- Solid and rigid matrix is made of collagen and calcium salts.
B. Supportive connective tissue: Bone

- 2 types are distinguished by types of fibers.
  1. **Compact** – made of repeating circular units called osteons which contain the hard matrix, living cells, and blood vessels
     Location: Shafts of long bones
  2. **Spongy** – an open latticework with irregular spaces
     Location: Ends of long bones
What do bone and cartilage look like?

Figure 4.2 Connective tissues in the knee.
C. Fluid connective tissue: Blood

- Made of a fluid matrix called **plasma** and cellular components that are called formed elements

- **3 formed elements:**
  1. **Red blood cells** (erythrocytes) – cells that carry oxygen
  2. **White blood cells** (leukocytes) – cells that fight infection
  3. **Platelets** (thrombocytes) – pieces of cells that clot blood
C. Fluid connective tissue: Blood

Figure 4.3  The formed elements of blood.
C. Fluid connective tissue: Lymph

- Matrix is a fluid called lymph.
- White blood cells congregate in lymph nodes.
2. Muscle tissue

- It allows for movement in the body.

- It is 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, and C. cardiac.
4.3 Muscular Tissue Moves the Body

A. Muscle tissue - Skeletal

- Appearance: long, cylindrical cells, multiple nuclei, striated fibers

- Location: attached to bone for movement

- Nature: voluntary movement

Figure 4.5a. The three types of muscle tissue.
B. Muscle tissue - Smooth

- **Appearance:** spindle-shaped cell with one nucleus, lacks striations
- **Location:** walls of hollow organs and vessels
- **Nature:** involuntary movement

*Figure 4.5b.* The three types of muscle tissue.
C. Muscle tissue – Cardiac

- **Appearance:** branched cells with a single nucleus, striations with darker striations called intercalated disks between cells
- **Location:** heart
- **Nature:** involuntary movement

**Figure 4.5c.** The three types of muscle tissue.
3. Nervous tissue

- It allows for communication between cells through sensory input, integration of data, and motor output.

- It is made of 2 major cell types: A. neurons and B. neuroglia.
A. Nervous tissue - neurons

- They are made of dendrites, a cell body, and an axon.

- Dendrites carry information toward the cell body.

- Axons carry information away from the cell body.

Figure 4.6. A neuron and examples of supporting neuroglia cells.
A. Nervous tissue - neuroglia

- They are a collection of cells that support and nourish neurons.
- They outnumber neurons 9:1.
- Examples are oligodendrocytes, astrocytes, and microglia.

Figure 4.6. A neuron and examples of supporting neuroglia cells.
4. Epithelial tissue

- It is a group of cells that forms a tight, continuous network.
- It lines body cavities, covers body surfaces, and is found in glands.
- Cells are anchored by a basement membrane on one side and free on the other side.
- It is named after the appearance of cell layers and the shape of the cells.
- There is transitional epithelium that changes in appearance in response to tension.
How do we name epithelial tissue?

- Number of cell layers
  - Simple (one layer of cells)
  - Pseudostratified (appears to have multiple layers but only has one layer)
  - Stratified (more than one layer of cells)

Figure 4.7a. Shapes of epithelial cells.
How do we name epithelial tissue?

- Shape of cell
  - Cuboidal (cube-shaped)
  - Columnar (column-shaped)
  - Squamous (flattened)

Figure 4.7b. Shapes of epithelial cells.
4.5 Epithelial Tissue Protects

What does epithelial tissue look like?

Figure 4.8. The basic types of epithelial cells.

- Simple squamous
  - Lining of lungs, blood vessels
  - Protects

- Simple cuboidal
  - Lining kidney tubules, various glands
  - Absorbs molecules

- Simple columnar
  - Lining of small intestine, oviducts
  - Absorbs nutrients

- Stratified squamous
  - Lining of nose, mouth, esophagus, anal canal, vagina
  - Protects

- Pseudostratified, ciliated columnar
  - Lining of trachea
  - Sweeps impurities towards that

- Goblet cell
  - Secretes mucus

- Basement membrane
The integumentary system

- It includes the skin and accessory organs such as hair, nails, and glands.

- The skin has 2 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.

- It is important for maintaining homeostasis.
What are the functions of the integumentary system?

1. It protects the body from physical trauma, invasion by pathogens, and water loss.
2. It helps regulate body temperature.
3. It allows us to be aware of our surroundings through sensory receptors.
4. It synthesizes chemicals such as melanin and vitamin D.
There are 2 regions of the skin

- Epidermis
- Dermis

Figure 4.9. Anatomy of human skin.
The epidermis

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

• It is the thick, inner layer of the skin.

• It is made of dense fibrous connective tissue.

• It contains elastic and collagen fibers.

• It contains blood vessels, many sensory receptors, and glands.
Where are skin cells keratinized?

Figure 4.10. A light micrograph of human skin.
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 you need to know about skin cancer?

• What can you do to help prevent this?
• Stay out of the sun between 10 A.M. and 3 P.M.
• Wear protective clothing (tight weave, treated sunglasses, wide-brimmed hat).
• Use sunscreen with an SPF of at least 15 that protects from UV-A and UV-B rays.
• Do not use tanning beds.
What might skin cancer look like?

a. Basal cell carcinoma
b. Melanoma

Figure 4.11. Cancers of the skin.
What are the accessory organs of the skin and why are they important?

• They include nails, hair, and glands.
• **Nails** are derived from the epidermis and 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 the hair and skin and retards bacterial growth.
• **Sweat glands** are derived from the dermis and help to regulate body temperature.
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.
4.7 Organ Systems, Body Cavities, and Membranes

What are the organ systems of the human body?

**Integumentary systems**
- protects body
- provides temperature Homeostasis
- synthesizes vitamin D
- receives sensory input
Organ: Skin

**Cardiovascular systems**
- transport system for nutrients, waste
- provides temperature, pH, and fluid homeostasis
Organ: Heart

**Lymphatic and Immune systems**
- defends against infectious diseases
- provides fluid homeostasis
- assists in absorption and transport of fats
Organs: Lymphatic vessels, lymph nodes, spleen

**Digestive system**
- ingests, digests, and processes food
- absorbs nutrients and eliminates waste
- involved in fluid homeostasis
Organs: Oral cavity, esophagus, stomach, small intestine, large intestine, salivary glands, liver, gallbladder, pancreas

**Respiratory system**
- exchanges gases at both lungs and tissues
- assists in pH homeostasis
Organs: Lungs

**Urinary system**
- excretes metabolic wastes
- provides pH and fluids homeostasis
Organs: Kidneys, urinary bladder

*Figure 4.13. Organ systems of the body.*
What are the organ systems of the human body?

**Skeletal system**
- provides support and protection
- assists in movement
- stores minerals
- produces blood cells
  Organs: Bones

**Muscular system**
- assists in movement and posture
- produces heat
  Organs: Muscles

**Nervous system**
- receives, processes, and stores sensory input
- provides motor output
- coordinates organ systems
  Organs: Brain, spinal cord

**Endocrine system**
- produces hormones
- coordinates organ systems
- regulates metabolism and stress response
- involved fluid and pH homeostasis
  Organs: Testes, ovaries, adrenal glands, pancreas, thymus, thyroid, pineal gland

**Reproductive system**
- produces and transports gametes
- nurtures and gives birth to offspring in females
  Organs: Testes, penis, ovaries, uterus, vagina

*Figure 4.13. Organ systems of the body.*
What are the body cavities?

**Thoracic cavity:**
- Contains heart, lungs, and esophagus

**Abdominal cavity:**
- Contains digestive and other organs

**Pelvic cavity:**
- Contains reproductive and other organs

**Cranial cavity:**
- Contains brain

**Vertebral cavity:**
- Contains spinal cord

**Dorsal cavity**

**Ventral cavity**

**Figure 4.14.** Body cavities of humans.
What about the body membranes that line the cavities?

- **Mucous membranes** – line the digestive, respiratory, urinary, and reproductive systems.

- **Serous membranes** – line the lungs, heart, and abdominal cavity and cover the internal organs; named after their location:
  - Pleura: lungs
  - Peritoneum: abdominal cavity and organs
  - Pericardium: heart
What about the body membranes that line the cavities?

- Synovial membranes – line the cavities of freely movable joints
- Meninges – cover the brain and spinal cord
What is homeostasis?

- It is 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 result in illness or even death.
All systems are important in maintaining homeostasis

Endocrine System
- Endocrine glands secrete hormones, which also regulate and coordinate the activities of other systems. Works more slowly than the nervous system.

Respiratory System
- Supplies blood with oxygen for tissue cells and rids blood of carbon dioxide. Helps regulate the acid–base balance of the blood.

Urinary System

Lymphatic System
- Helps maintain blood volume by collecting excess tissue fluid and returning it via lymphatic vessels to the cardiovascular veins. Defends against disease.

Integumentary System
- Helps maintain body temperature and protects internal organs.

Figure 4.15. Homeostasis by the organ systems of the human body.
What are the mechanisms for maintaining homeostasis?

- **Negative feedback** – the output of the system resolves or corrects the original stimulus.

- **Positive feedback** – brings about an increasing change in the same direction as the original stimulus.
Negative feedback

- The primary mechanism for maintaining homeostasis
- The output of the system dampens the original stimulus
- Has 2 components
  - sensor
  - control center

Figure 4.16. Negative feedback mechanisms.
An example of negative feedback: Body temperature

Figure 4.18. Body temperature homeostasis.
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