

# Exam 3 - Notes

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# Chapter 40

## Intro to Animal Structure(Form) & Function

### Key concepts

- organization of animal bodies
- the relationship between structure and function
- homeostasis

### All Animals:

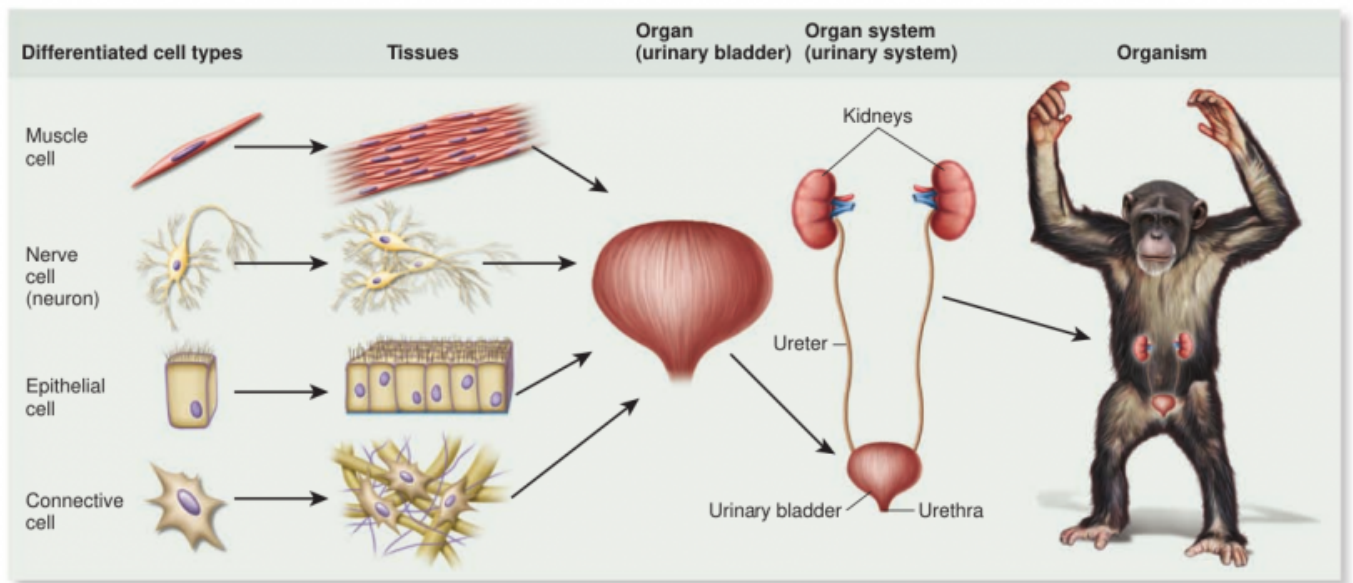
Share similarities in the ways in which they:

- Exchange materials with their surroundings
- Obtain energy from organic molecules
- synthesize complex molecules
- reproduce themselves
- detect and respond to signals in their immediate surroundings

## Levels of Animal Organization

- Cellular
  - Phylum Porifera
- Tissue
  - Phylum Cnidaria
  - Phylum Ctenophora
- Organ System
  - All advanced animal groups

## Internal Organization of Animals



**Figure 40.1** The internal organization of cells, tissues, organs, and organ systems in a mammal. Most animals share the same four tissue types.

- **Cells** with similar properties group together to form **tissues**
- **Tissues** combine together to form **organs**
- **Organs** are linked together to form **organ systems**
- **Organ Systems** form an **organism**

# Tissues

## Tissue

- An association of many cells that have a similar structure and function

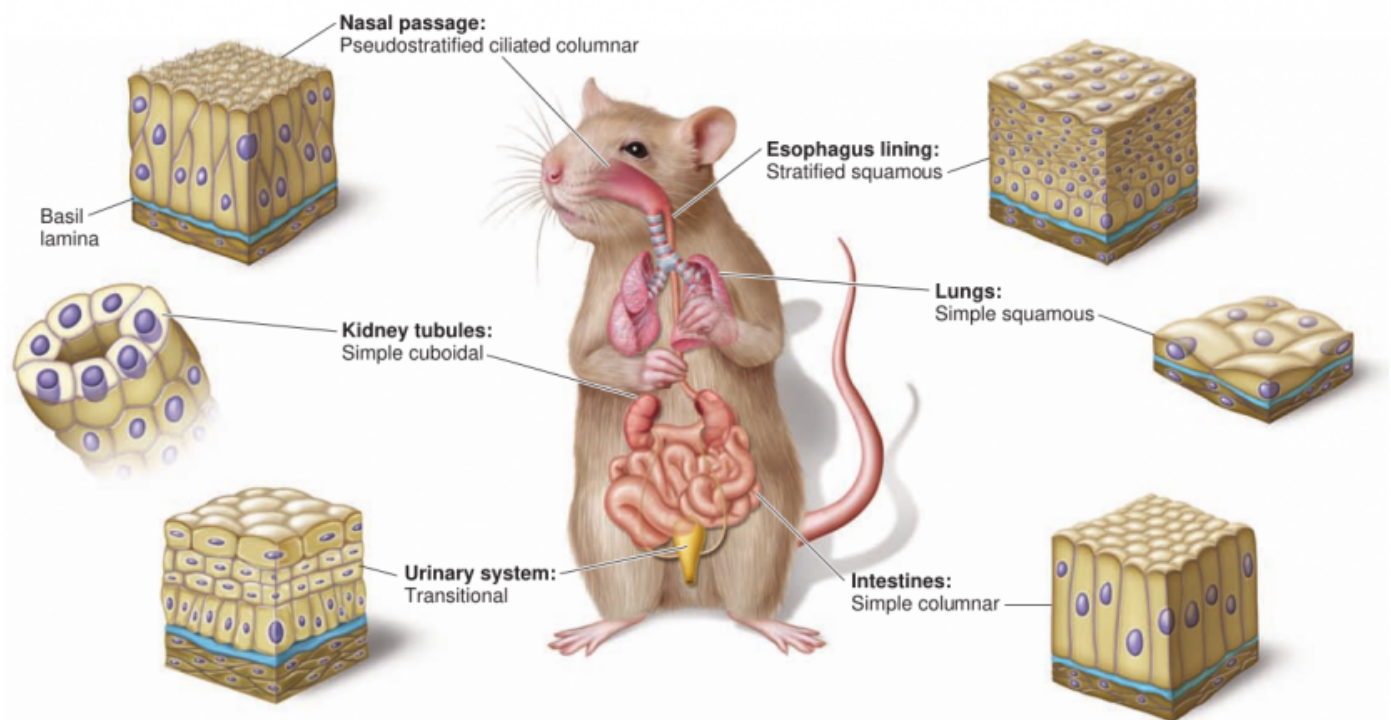
## Types

- Epithelial tissue
- Connective tissue
- Muscle tissue
- Nervous tissue

# Epithelial

- Sheets of densely-packed cells that:
  - cover the body or enclose organs
  - line the walls of the body cavity and organs

- Specialized to protect and secrete/absorb ions and organic molecules
- cells have a variety of shapes
  - cuboidal
  - squamous
  - columnar
- arranged to form different types of tissues
  - simple
    - one layer
  - stratified
    - multi layer
  - pseudo-stratified
    - one layer, but appears stratified
- All are asymmetrical or polarized
  - One side rests on the basal lamina (basement membrane)
  - the other faces the environment



**Figure 40.4** Examples of epithelial tissue. There are several types of epithelial tissue, distinguished by their appearance. Epithelial tissue is used to construct body coverings and the protective sheets that line and cover hollow tubes and cavities.

## Types of Epithelial Tissue

- Simple squamous
  - one layer of flat cells
- Simple cuboidal
  - one layer of square cells
- Simple columnar
  - single layer of rectangular cells

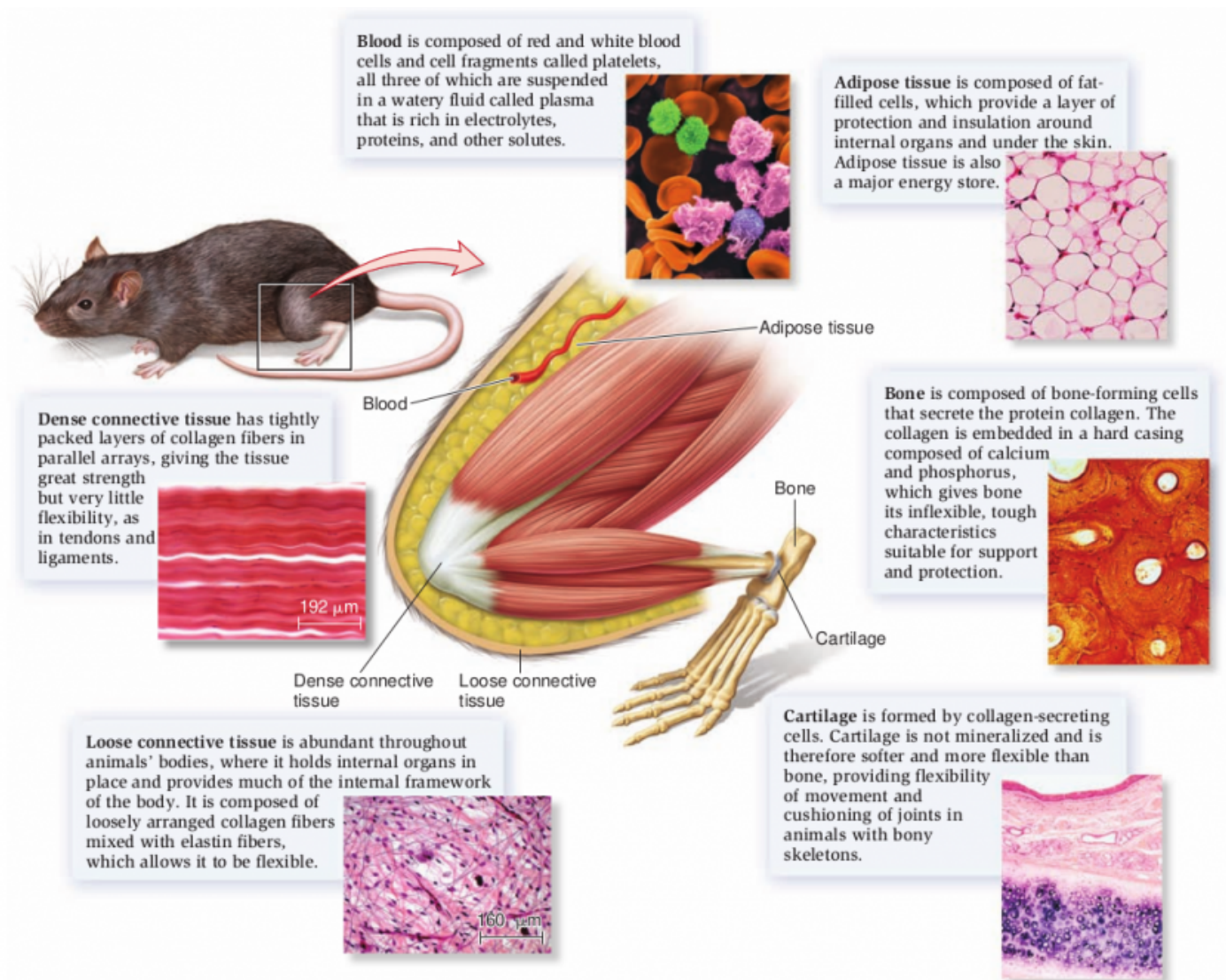
- Pseudo-stratified columnar
  - 1 cell thick with all at basement barrier
- Stratified squamous
  - multi-layered flattened cells
- Transitional
  - stretchable tissue

All may be involved with secretions/absorption/protection

# Connective tissues

Connect, surround, anchor, bind, & support

- For extracellular matrix (ECM) around cells
  - provides scaffolds for attachment
  - protects and cushions
  - mechanical strength
  - transmit information
  - transport



**Figure 40.5** Examples of connective tissue in mammals. Connective tissue connects, surrounds, anchors, and supports other tissues and may exist as isolated cells (blood), clumps of cells (fat), or tough, rigid material (bone and cartilage). The samples have been stained or the micrographs have been computer-colored to reveal connective tissue.

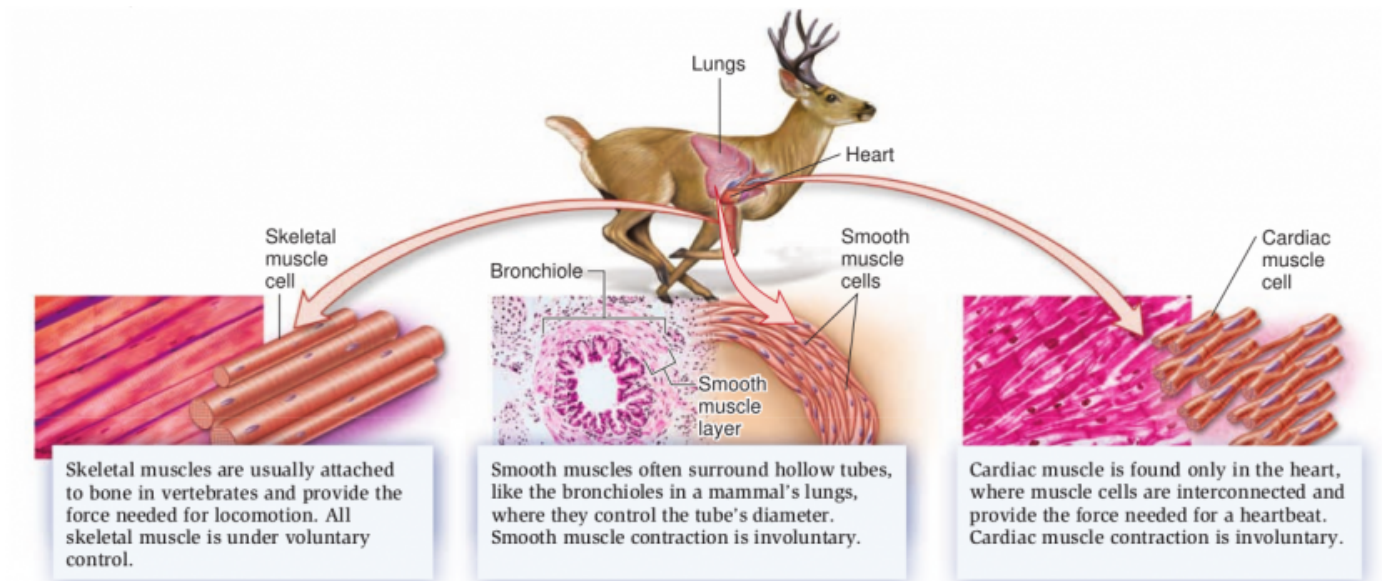
# Types of Connective tissue

- Blood
  - transport and protection
- adipose (fat)
  - insulation, protection, support, and storage
- bone
  - support, protections, and movement
- cartilage
  - support and flexibility
- loose connective tissue
  - holds internal organs in place
- dense connective tissue
  - strength and support



# Muscle Tissues

Cells specialized to contract, generating mechanical force



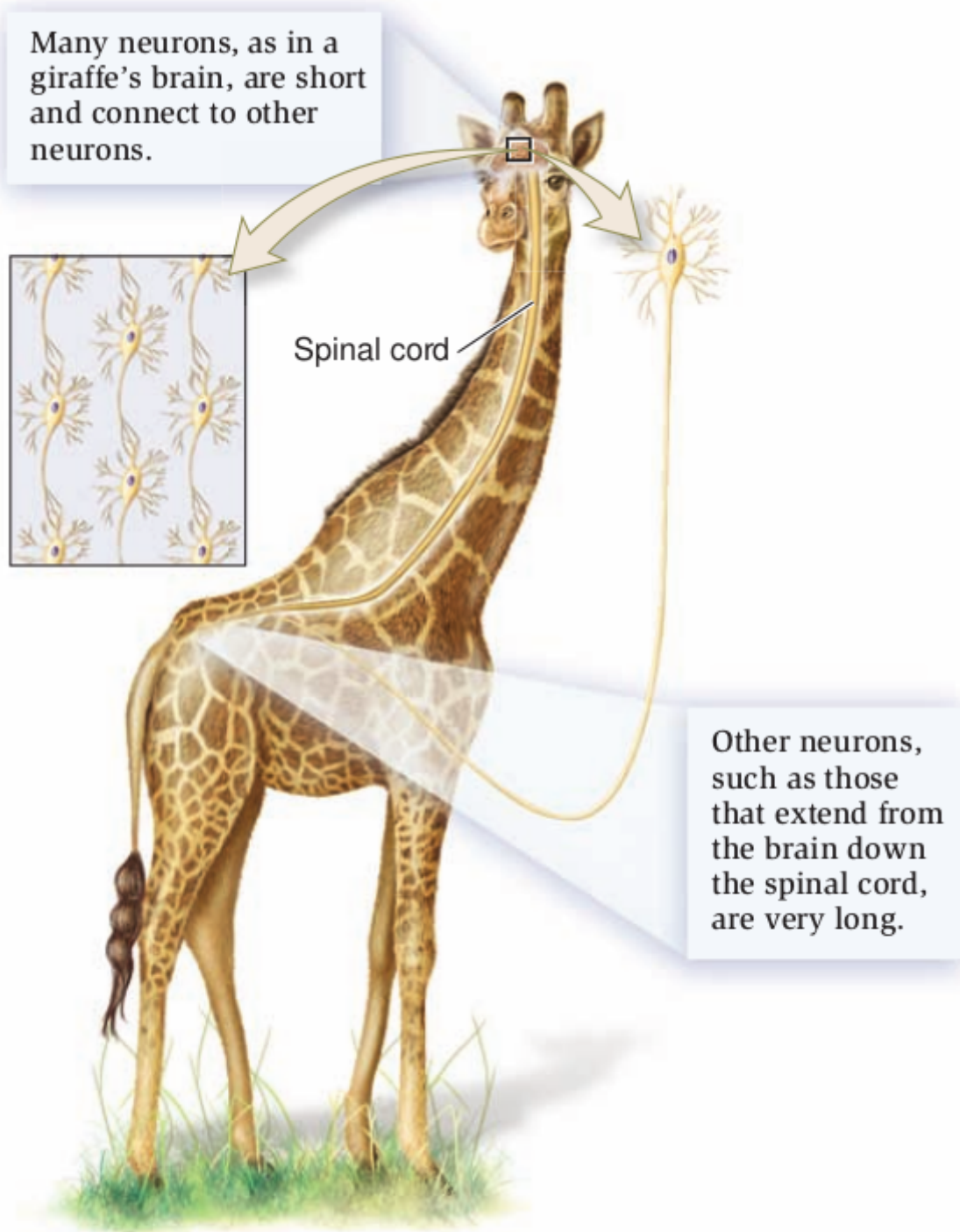
**Figure 40.2** Three types of muscle tissue: skeletal, smooth, and cardiac. All three types produce force, but they differ in their appearance and in their locations within animals' bodies. (Right inset: © Dr. Richard Kessel & Dr. Gene Shih/Visuals Unlimited)

## Types of muscle tissue

- Skeleton muscle
  - attached to bone(via connective tissue) or exoskeleton for locomotion
  - elongated fibers
  - voluntary control
  - striated
- Smooth muscle
  - surrounds tubes and body cavities for propulsion of contents
  - flattened cells
  - involuntary control
- cardiac muscle
  - only in the heart
  - elongated fibers
  - involuntary control
  - striated
  - branched

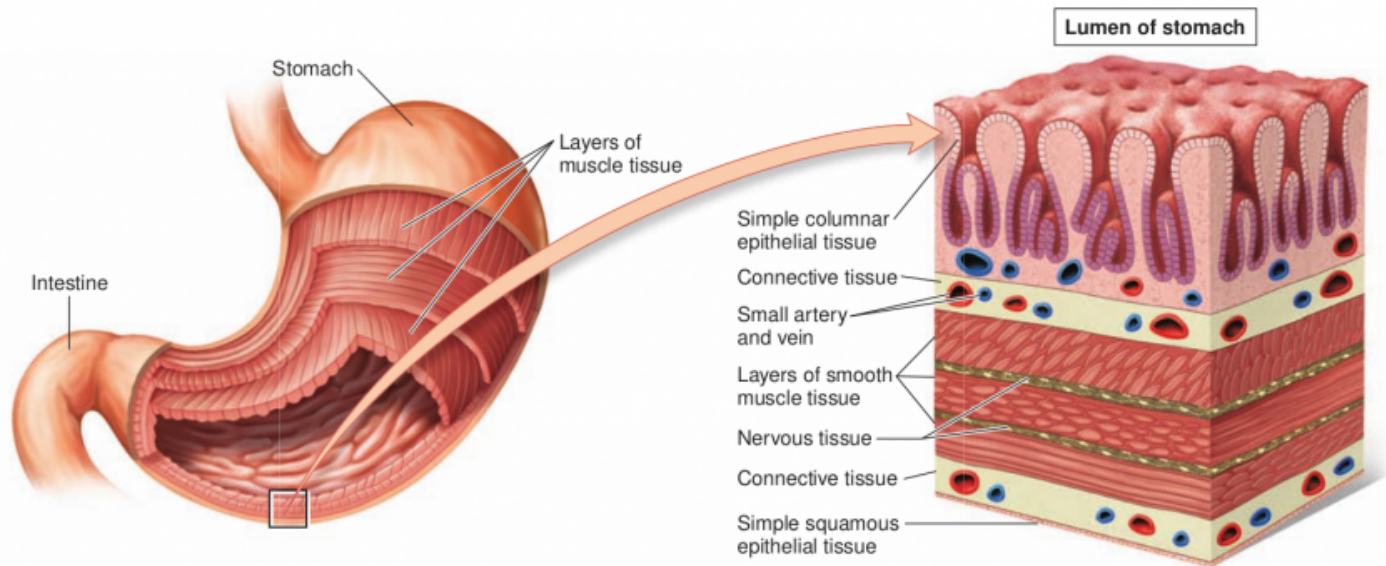
## Nervous tissue

- complex networks of neurons (nerve cells)
- initiate and conduct electrical signals from one part of the body to another
- electrical signals produced in one neuron may stimulate or inhibit other neurons
  - initiate new electrical signals
  - stimulate muscle cells to contract
  - stimulate glandular cells to release chemicals
- also contains neuro-glial cells
  - more numerous than neurons
  - provide metabolic support, maintenance, ion balance, and cleaning for the neurons



**Figure 40.3** Variation in shape and length of neurons.





**Figure 40.6** The vertebrate stomach as an example of an organ composed of all four tissue types. In this illustration, the thickness and appearance of the layers of nervous tissue have been considerably exaggerated for visual clarity.

# Organ Systems

Table 40.1 Organ Systems Found in Animals		
Organ system	Major components*	Major functions
Circulatory	Contractile element (heart or vessel); distribution network (blood vessels); blood or hemolymph	Transports and distributes solutes (nutrients, gases, wastes, and so on) to and from all parts of an animal's body
Digestive	Ingestion structures (mouth or mouthparts); storage structures (crop, stomach); digestive and absorptive structures (stomach, intestines); elimination structures (rectum, anus); accessory structures (pancreas, gallbladder)	Breaks complex foods into smaller, absorbable units; absorbs organic nutrients, salts, and water; eliminates solid wastes
Endocrine	All glands, organs, or tissues that secrete hormones; examples include the pituitary and thyroid glands	Regulates and coordinates processes such as growth, development, metabolism, mineral balance, and reproduction
Excretory	Filtration system (kidneys or comparable structures); storage sites for soluble wastes (bladder); tubes connecting kidneys and bladder, and bladder to external environment	Eliminates soluble metabolic wastes; regulates body fluid volume and solute concentrations
Immune and lymphatic	Circulating white blood cells; lymph vessels and nodes	Defends against pathogens
Integumentary	Body surfaces (skin)	Protects from dehydration and injury; defends against pathogens; regulates body temperature; in some animals, transports gases and fluids
Muscular-skeletal	Force-producing structures (muscles); support structures (bones, cartilage, exoskeleton); connective structures (tendons, ligaments)	Produces locomotion; generates force; propels materials through body organs; supports body
Nervous	Processing (brain); signal delivery (spinal cord, peripheral nerves and ganglia, sense organs)	Regulates and coordinates many body activities, such as movement, sensation, and learning
Reproductive	Gonads and associated structures	Produces gametes (sperm and egg); in some animals, provides nutritive environment for embryo and fetus
Respiratory	Gas exchange sites (gills, skin, trachea, lungs)	Exchanges oxygen and carbon dioxide with environment; regulates blood pH

\*Selected examples only; these do not necessarily pertain to all animals.

10 organ systems that we will cover (not in this order)

## Structure and function

- organization of structure(form) can predict the function of a structure
- we will concentrate of the increasing complexity of structural(form), and thus the increasing complexity of organismal function
- most emphasis on vertebrates

# Homeostasis

- changing variables in environmental:
  - air temperature
  - water temperature
  - food supply
  - water supply
  - pH
  - O<sub>2</sub> Concentration
- Process of adjusting to the external environment and maintaining a stable internal environment

# Integumentary System

Apparently there is no chapter/section for this in the book?

## Integument

- the skin and all accessory structure (hair, feathers, scales)

## Skin

- The largest vertebrate organ
- major part of the integument system

## Vertebrate integument and derivatives

## Functions

- Protection from abrasion
- protects against water loss
- barrier to disease causing pathogens
- protection from UV light
- temperature regulation
- contains sensory receptors
- excretion (limited)

## Vertebrate Integument

- skin and all other accessories
- skin is the largest organ of vertebrates

- skin consists of 2 layers
  - epidermis
  - dermis

# Epidermis

- outer layer
- nutrients diffuse into the epidermis from the dermis
- stratified squamous epithelial cells

## Cell types

- langerhans cells
  - defensive cells
- Melanocytes
  - produce pigment melanin
  - skin coloration
  - protect from UV light
- Merkel cells
  - touch receptors
- Keratinocytes
  - primary cell type
  - produce insoluble protein Keratin
  - amount of keratin increases from the inside to outside
  - keratin fill cytoplasm and impairs nutrient diffusion, cell dies

# Dermis

- Inner layer of skin
  - thinner than epidermis
- highly vascularized
- contains:
  - sensory structures
  - vessels
  - nerves
  - glands
- Origin of hair/scales/feathers in vertebrates
- Sensory structures
  - Meissner's corpuscles
    - light touch
  - Pacinian corpuscles
    - deep vibrations

# Sweat Glands

- temperature regulation
- produce sweat (primarily water)
  - evaporating cooling
  - release of waste ions
- 2.5 million on the body
- release of heat

# Sebaceous Glands

- all over body, except palms and soles
- large on face, neck, and upper chest
- produce sebum
  - lubricates and soften hair and skin
  - water proofing in aquatic mammals

# Hypodermis

- subcutaneous layer
  - below the dermis
- not a layer of the skin
- contains much adipose (fat) tissue
- females have thicker layer of adipose tissue than males

# Function

- body contour
- insulation
- support the skin

# Chapter 45 & 46

## Digestive System

### Key Concepts

- Animal nutrition
- general principles of digestion and absorption of food
- overview of vertebrate digestive systems
- mechanisms of digestion and absorption in vertebrates

## Intro to nutrition

- nutrient
  - any substance taken in by an organism that is needed for:
    - survival
    - growth
    - development
    - tissue repair
    - or reproduction
- nutrition
  - process of consuming and using food for nutrients
- animals receive nutrients by consuming food

## Dietary categories

- basic similarities in organ system function lead to similarities in nutritional requirements
- different animal physiologies can have different nutrient demands

- Herbivores
  - eat only plants
  - digestive system contains micro-organisms that help digest cellulose
- Carnivores



- eat only animal flesh or fluid
- Omnivores
  - eat both

# Animals are heterotrophic

- Heterotrophs
  - ingest feeders
- cannot manufacture more food
- require already synthesized organic compounds of plants of other animals to supply materials
  - survival
  - maintenance
  - growth
  - reproduction

# Gut Tracts

Two types

1. Blind Gut
  - no cavity between gut and body wall
  - one opening
  - primitive form
2. tube-within-a-tube
  - flow through digestive tube
  - body cavity between gut and body wall
  - separate opening (mostly)

# Digestion

- the breakdown of large molecules into smaller ones

# Digestive enzymes (hydrolases)

- carbohydrases
- proteases
- lipases
- nucleases

# Food processing in animals

Occurs in Five phases

1. Ingestion
  - food is taken into the body and moves into a digestive
2. digestion
  - food is broken down into smaller molecules
  - chemical and mechanical
3. transport
4. absorption
  - ions, water, and small molecules are transported into the circulatory system
5. egestion
  - undigested materials and other waste are passed from the body
  - elimination or excretion

## Alimentary canal

- digestive tract or tube
  - Gastrointestinal tract
- Five regions of food processing
- Single tube with opening at each end
- contains smooth muscles in walls
- lined with epithelial cells
  - synthesize and secrete digestive enzymes
  - secrete hormones
  - transport digestive materials
- several specialized regions
  - different structures for different processes
  - storage area

## Structure of GI Tract

- some general structure from midpoint of esophagus, to the anus or cloaca
  - lumen lined by epithelial and glandular cells
  - secretory cells release a protective layer of mucus
  - other cells release hormones
  - glands release enzymes, acids, water, and ions
- Epithelial cells linked by tight junctions and surrounded by layers of tissue made of smooth muscle, neurons, connective tissues, and blood vessels
  - neurons activated by sight and smell of food and presence of food in tract

## Region of Reception

## Buccal cavity

- mouth and accessory structures
- ingestion site and digestion site
- chemical and mechanical
- jaws, teeth, cheek muscles, tongue, and salivary glands (saliva)

## Pharynx

- back of mouth cavity
- point that respiratory and digestive system cross paths

## Region of Conduction

### Esophagus

- tube carrying materials from mouth cavity to the rest of the alimentary canal
- forces/pushes food down
- conducts food from pharynx to stomach
- Peristalsis
  - rhythmic wave-like contractions which propel food forward in the GI tract
- No new digestion here
  - only chemical continuation from buccal cavity

## Region of digestion and storage

### Stomach (mostly)

- saclike organ evolved for storing food
- muscular nature helps break up food
- partial protein digestion
- regulates rate of emptying into small intestine
- Secretions
  - hydrochloric acid
    - kills microbes
    - dissolves particulate matter
    - secreted by parietal cells
  - Pepsinogen
    - converted to pepsin to begin protein digestion
    - secreted by Chief cells
- Epithelium coated with an alkaline mucus
- carbohydrate digestion continues from mouth
- little lipid digestion happens
- lumen (cavity) stomach
  - pepsinogen + HCL -> pepsin (for protein breakdown)

# Region of terminal digestion and absorption

## Small intestine

- near

# Chapter 41 - 43 (mostly 41)

## Nervous System

# Chapter 44

## Musculoskeletal system