Kingdom Animalia

Chapter 26
Page 657

Animals are multicellular, eukaryotic heterotrophs whose cells lack cell walls.

Nov 30-11:34 PM

Invertebrates are animals that do **not** have a backbone, or vertebral column.

Over 95% of Animal Species

Vertebrates are animals that **do** have a backbone.

Less than 5% of Animal Species

Animal Phyla

Appendix E - Classification - Page 1074

Phylum Porifera (sponges)
Phylum Cnidaria (jellyfish, sea anemones, corals)
Phylum Platyhelminthes (flatworms)
Phylum Nematoda (roundworms)
Phylum Annelida (segmented worms)
Phylum Mollusca (mollusks - snails, slugs, clams, squid, octopi)
Phylum Arthropoda (insects, crabs, centipedes, spiders)
Phylum Echinodermata (sea stars, sea urchins, sand dollars)
Phylum Chordata (fish, amphibians, reptiles, birds and mammals)

Early Development

(Page 661)

Animals that reproduce sexually begin life as a zygote, or fertilized egg. (egg + sperm => zygote)

Embryology is the study of the formation and growth of embryos.

▶ **Figure 26–4** During the early development of animal embryos, cells divide to produce a hollow ball of cells called a blastula. An opening called a blastopore forms in this ball. In protostomes, the blastopore develops into the mouth. In deuterostomes, the blastopore forms an anus.

Page 661

blastula - a hollow ball of cells
- folds in on itself to form a blastopore

blastopore - leads into a central tube that runs the length of the developing embryo

protostome - an animal whose mouth is formed from the blastopore

deuterostome - an animal whose anus is formed from the blastopore

anus - opening through which wastes leave the digestive tract

Three Germ Layers

(Cell Layers)

During early development, the cells of most animal embryos differentiate into three layers called germ layers.

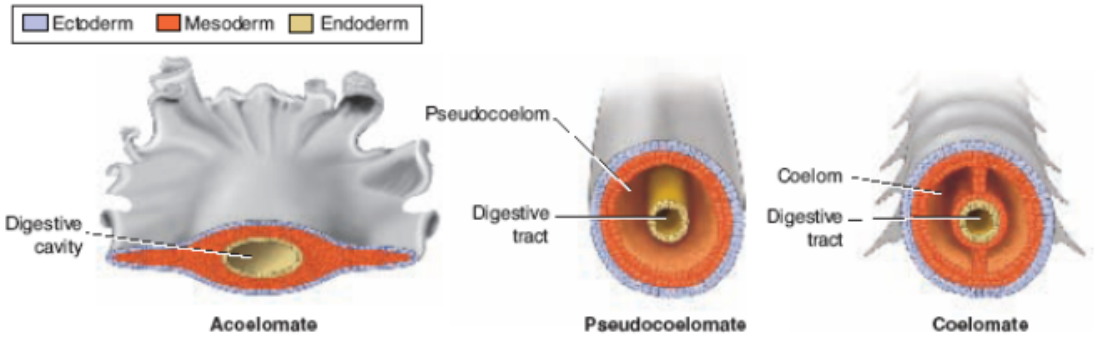
endoderm - innermost layer of cells
- develop into the linings of the digestive tract and much of the respiratory system

mesoderm - middle layer of cells
- gives rise to muscles and much of the circulatory, reproductive, and excretory organ systems

ectoderm - outermost layer of cells
- gives rise to sense organs, nerves and the outer layer of skin

Dec 1-1:07 AM

Most complex animal phyla are coelomates meaning that they have a true coelom, or body cavity between their body wall and digestive cavity that is lined completely with tissues from the mesoderm.



- do not have a coelom

- body cavities are partially lined with mesodermal tissues

Dec 1-1:56 AM

Body Symmetry

(Page 662)

With the exception of sponges, every kind of animal exhibits some type of body symmetry in its anatomy, or body structure.

radial symmetry - body plan in which body parts repeat around the center of the body
- any number of imaginary planes can be drawn through the center
- characteristic of sea anemones and sea stars

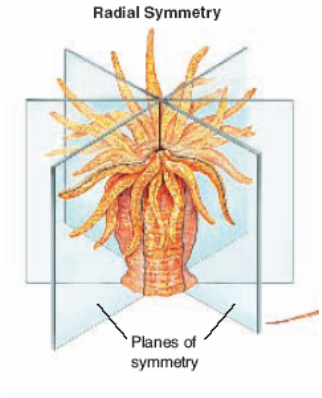
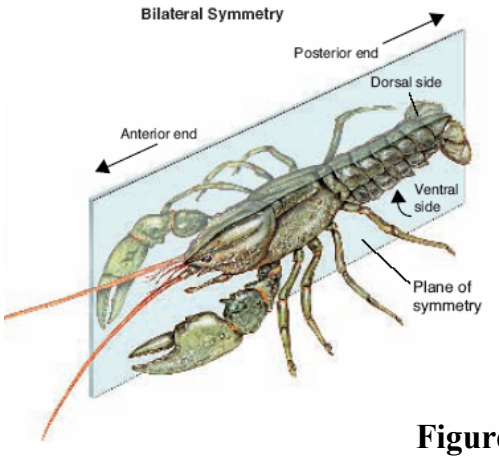


Figure 26-5
(Page 662)

bilateral symmetry - body plan in which only a single, imaginary line can divide the body into two equal halves
- characteristic of worms, arthropods and chordates



right side/left side

anterior - front end

posterior - back end

dorsal - upper side

ventral - lower side

Figure 26-5
(Page 662)

An anatomy with bilateral symmetry allows for segmentation, in which the body is constructed of many repeated and similar parts or segments.

Dec 1-1:32 AM

Cephalization

(Page 663)

Animals with bilateral symmetry usually exhibit the anatomical characteristic called cephalization. Cephalization is the concentration of sensory organs and nerve cells at the front end of the body.

Invertebrates with cephalization can respond to the environment in more sophisticated ways than can simpler invertebrates.

In general, the more complex an animal becomes, the more pronounced their cephalization. The anterior end is often different enough from the rest of the body that is is called a head.

Comparing Invertebrates

Chapter 29
Page 748

Figure 29-5

Comparing Invertebrates

	Sponges	Cnidarians	Flatworms
Germ Layers	Absent	Two	Three
Body Symmetry	Absent	Radial	Bilateral
Cephalization	Absent	Absent	Present
Coelom	Absent	Absent	Absent
Early Development	———	———	Protostome

	Roundworms	Annelids	Mollusks	Arthropods	Echinoderms
Germ Layers	Three	Three	Three	Three	Three
Body Symmetry	Bilateral	Bilateral	Bilateral	Bilateral	Radial (adults)
Cephalization	Present	Present	Present	Present	Absent (adults)
Coelom	Pseudocoelom	True coelom	True coelom	True coelom	True coelom
Early Development	Protostome	Protostome	Protostome	Protostome	Deuterostome

What Animals Do to Survive

(Page 658-659)

Animals carry out the following essential functions:

- feeding
- digestion
- respiration
- circulation
- excretion
- response
- movement
- reproduction

Many body functions help animals maintain homeostasis, or a relatively stable internal environment.

Dec 1-12:09 AM

Feeding and Digestion

Chapter 29 - Page 751

Invertebrates have evolved many different ways of obtaining food.

intracellular digestion -> process in which food is digested inside the cell
-> simplest organisms use this method (sponges)

extracellular digestion -> process in which food is broken down outside the cells in a digestive tract
-> more complex organisms use this method (mollusks, annelids, arthropods, echinoderms)

* Flatworms and cnidarians use both types of digestion

Dec 1-10:34 PM

Invertebrates have a variety of digestive systems.

Simple animals ingest food and expel wastes through a single opening.

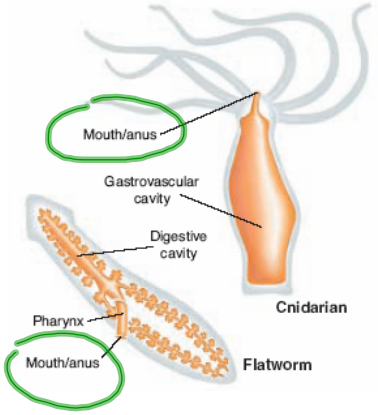


Figure 29-8
Page 752

More complex animals digest food in a tube called the digestive tract. Food enters the body through the mouth, and wastes leave through the anus.

A one-way digestive tract often has specialized regions, such as stomach and intestines. Specialization of the digestive tract allows food to be processed more efficiently, because each step in the process takes place in order, at a specific place along the digestive tract.

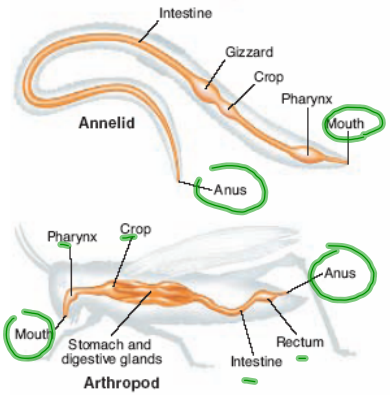


Figure 29-8
Page 752

pharynx - muscular tube
- connects the mouth to the rest of the digestive tract
- serves as a passageway for food and air

crop - in earthworms, part of the digestive system in which food can be stored

gizzard - in earthworms, part of the digestive tract in which food is ground into smaller pieces

Dec 1-10:47 PM

Respiration

Chapter 29 - Page 752

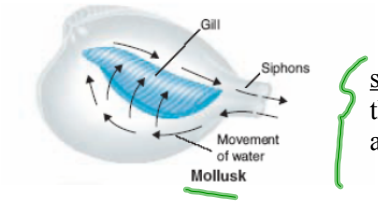
All animals must exchange oxygen and carbon dioxide with the environment.

All respiratory organs have large surface areas that are contact with the air or water. Also, for diffusion to occur the respiratory surfaces must be moist.

Many aquatic invertebrates exchange gases through gills.

gills - feathery structures that expose a large surface area to the water
- rich in blood vessels that bring blood close to the surface for gas exchange

Figure 29-9
Page 753



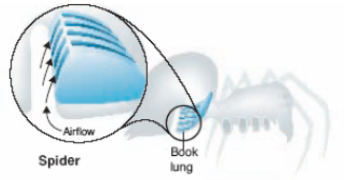
siphon - tubelike structure through which water enters and leaves a mollusk's body

In terrestrial invertebrates, respiratory surfaces are covered with water or mucus to minimize water loss. In addition, air is moistened as it travels through the body to the respiratory surface.

Invertebrates have several types of respiratory surfaces.

Spider

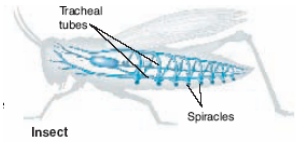
book lungs - made of parallel, sheetlike layers of thin tissues that contain blood vessels



Grasshopper

spiracles - small openings located along the side of the body through which air enters and leaves the body

tracheal tubes - where gases diffuse in and out of surrounding body fluids



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Circulation

Chapter 29 - Page 754

Most complex animals move blood through their bodies using one or more hearts and either an open or closed circulatory system

open circulatory system - one or more hearts or heartlike organs pump blood through blood vessels into a system of sinuses, or body cavities
- blood comes into direct contact with tissues

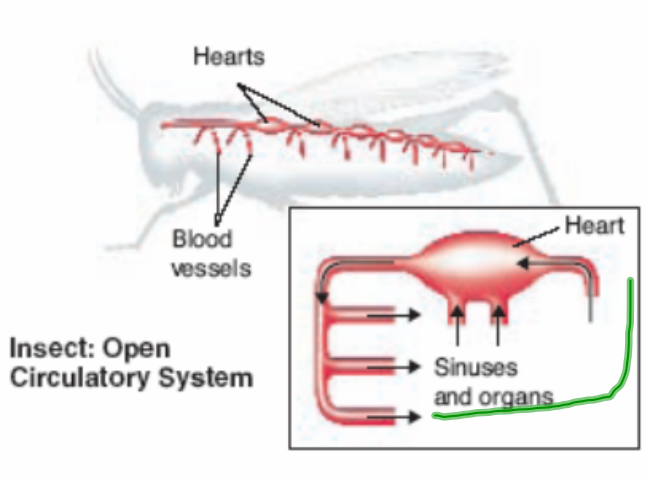


Figure 29-10
Page 754

closed circulatory system - a heart or heartlike organ forces blood through vessels that extend throughout the body
- materials reach tissues by diffusing across the walls of blood vessels

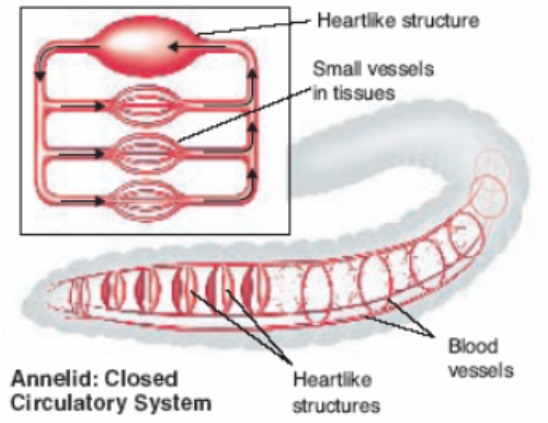


Figure 29-10
Page 754

Dec 1-11:49 PM

Excretion

Chapter 29 - Page 755

Most animals have an excretory system that rids the body of metabolic wastes (ammonia) while controlling the amount of water in the tissues.

In aquatic invertebrates, ammonia diffuses from their body tissues into the surrounding water.

Flatworms use a network of flame cells to eliminate excess water. Fluids travel through excretory tubules and leave the body through tiny pores in the animal's skin.

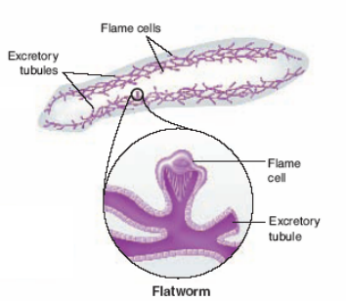


Figure 29-11
Page 755

Terrestrial invertebrates must conserve water while removing nitrogenous wastes.

ammonia -> urea

Urea is eliminated from the body in urine. Urine is highly concentrated so little water is lost.

In some invertebrates, urine forms in tubelike structures called nephridia. Fluid enters nephridia through structures called nephrostomes. Urine leaves the body through excretory pores.

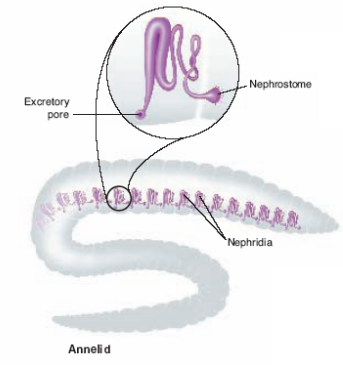


Figure 29-11
Page 755

Some insects and arachnids have Malpighian tubules, saclike organs that convert ammonia into uric acid. Uric acid and digestive wastes combine to form a thick paste that leaves the body through a structure called the rectum. There is little water loss because the paste contains little water.

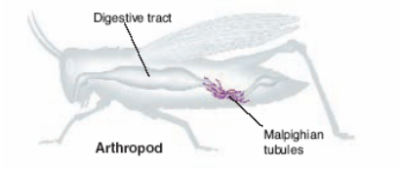


Figure 29-11
Page 755

Dec 2-12:06 AM

Response

Chapter 29 - Page 756

Nervous systems gather and process information from the environment and allow animals to respond appropriately.

Invertebrates show three trends in the evolution of the nervous system:

- centralization
- cephalization
- specialization

Centralization and Cephalization

simplest nervous systems -> nerve nets
ganglia -> clumps of nerve tissue
brain -> concentration of nerve tissue

Specialization

Complex animals may have a variety of specialized sense organs that detect light, sound, chemicals, movement and even electricity to help them discover what is happening around them.

Movement and Support

Chapter 29 - Page 756

Invertebrates have one of three main kinds of skeletal systems.

hydrostatic skeleton -> muscles surround a fluid-filled cavity that supports the muscles

exoskeletons (external skeleton) -> tough, external covering that protects and supports the body

endoskeleton - structural support inside the body

Sexual and Asexual Reproduction

Chapter 29 - Page 757

Most invertebrates reproduce sexually during at least part of their life cycle. Depending on environmental conditions, many invertebrates may also reproduce asexually.

Sexual Reproduction

female gamete
egg
haploid

male gamete
sperm
haploid

zygote
diploid

Usually, individual animals have a single sex and produce either sperm or eggs.

hermaphrodite - individual that produces both sperm and eggs
(ie/ earthworms)

---

external fertilization -> eggs are fertilized outside the female's body

internal fertilization -> eggs are fertilized inside the female's body

Asexual Reproduction

Asexual reproduction does not involve gametes.

All offspring are genetically identical to the parent.

In budding, new individuals are produced by outgrowths of the body wall. Some animals reproduce asexually by dividing in two.

Earthworm Dissection

Virtual Earthworm Dissection

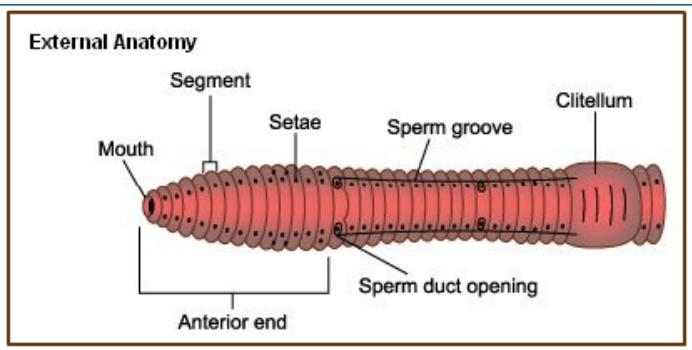
http://www.mhhe.com/biosci/genbio/virtual_labs/BL_14/BL_14.html

External/Internal Anatomy

Images

http://biog-101-104.bio.cornell.edu/biog101_104/tutorials/animals/earthworm.html

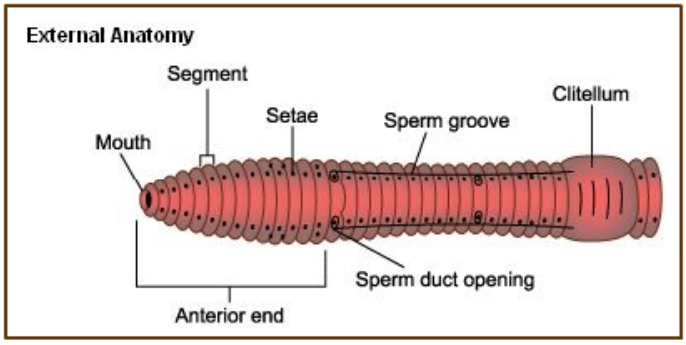
Dec 2-9:36 PM



Identify the external features of the earthworm in the dissecting tray. The **anterior end** of the earthworm is more cylindrical than the flattened **posterior end**. The **ventral side** of the earthworm is pale and slightly flattened. The **dorsal side** is dark and rounded. The dark, dorsal longitudinal blood vessel can be seen through the body wall on the dorsal midline.

The most distinguishing characteristics of earthworms are their cylindrical bodies that are divided into a series of **segments**. Each segment is separated from its neighbors by a groove. Internally, segments are separated by a body partition called septum. The earthworm has four pairs of two tiny bristles on the ventral half of each segment called **setae**. The earthworm uses setae to anchor in the soil while it moves forward by alternately contracting and relaxing the muscles in each segment. The **mouth** is located on the ventral surface of the first segment. An **anus** is in the center of the last segment.

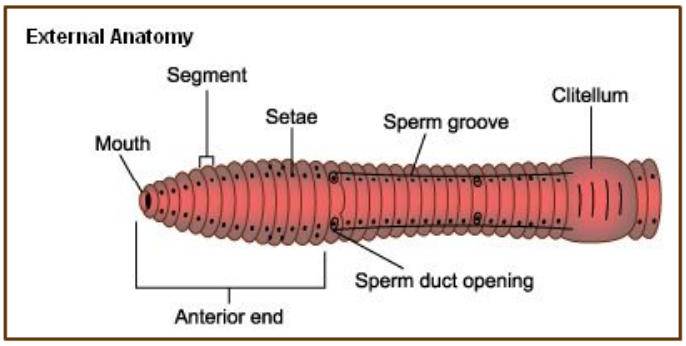
Page 1



Find the saddle-shaped swelling on the dorsal surface, closer to the anterior than the posterior end of the earthworm. This is called the **clitellum**. It produces a mucus sheath around the earthworms during mating, and secretes a capsule for the eggs and sperm of each earthworm.

The **sperm duct openings**, are slits on the ventral surface of segment fifteen. These slits are easy to find. All other openings on an earthworm are small and difficult to locate. A fine probe may be moved across the surface of the earthworm until it encounters a previously invisible opening and slips into it, to demonstrate that the opening is there. Two **sperm grooves** run between the inner and outer rows of setae from the sperm duct openings to the clitellum. The **seminal receptacle openings** are in the grooves between the ninth and tenth, as well as the tenth and eleventh segments. During mating, two earthworms exchange sperm while the clitellum of one earthworm is aligned with the **seminal receptacle openings** on segments nine and ten of the other earthworm.

Page 2

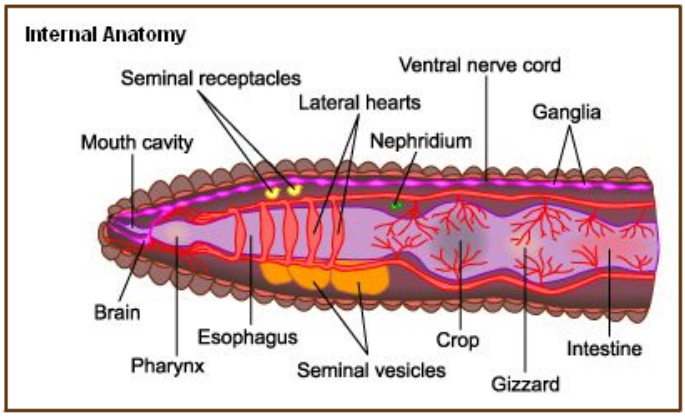


The **oviducts** have small openings next to the ventral pair of setae on the surface of segment fourteen.

Dorsal pores are openings from the coelom to the outside. These lie in the dorsal line grooves from segment twelve to the end of the earthworm's body.

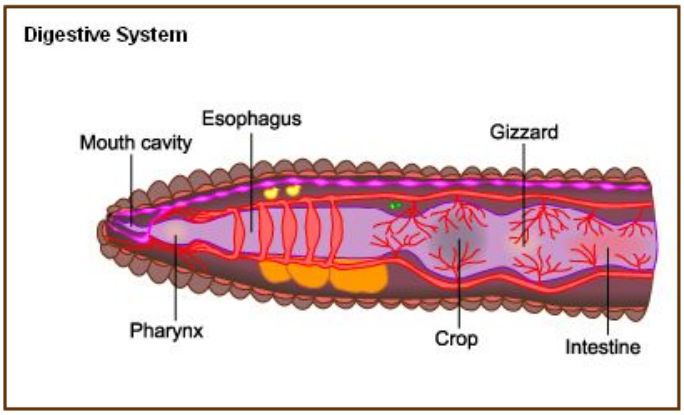
Most segments have a small **excretory opening** near the anterior edge. The **nephridia** or excretory structures eliminate metabolic wastes through these openings.

Page 3

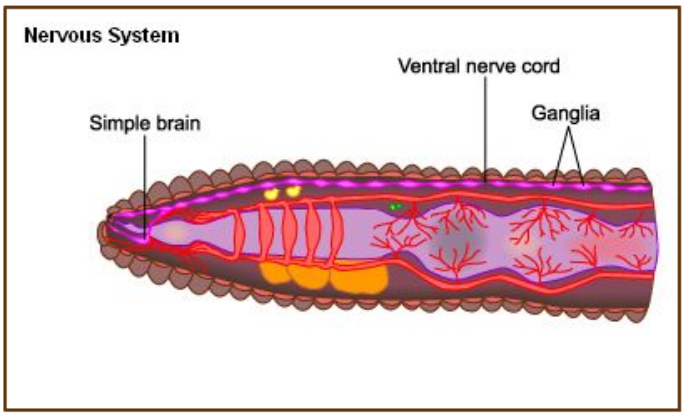


The earthworm is placed with its dorsal side up in the dissecting tray. It is pinned down through the first segment and further back behind the clitellum. A shallow slit is cut in the dorsal surface, starting about two centimeters behind the clitellum. The cut is continued forward to the first segment. Then the body partitions are cut between the segments so that the skin and muscle flap can be laid flat. Additional pins are placed to hold the flaps open to expose the internal organs.

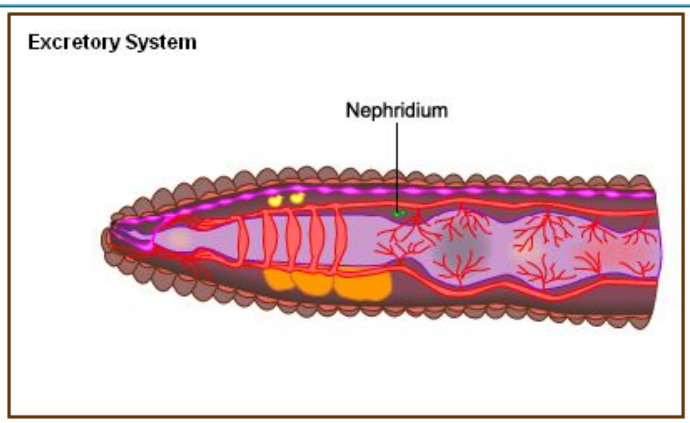
The first thing to note is the body cavity or coelom that surrounds the internal organs. Organs and structures that are visible in this longitudinal view are the digestive system, the circulatory and respiratory system, the nervous system, the excretory system, and the reproductive system.



Earthworms have a complete digestive tract. It is a tube that runs from the mouth to the anus. It begins with the **mouth cavity**, followed by the **pharynx**. Glands in the pharnyx secrete mucous and enzymes that aid in the passing food and soil through the esophagus. In this view, the slender **esophagus** is somewhat hidden under parts of the circulatory and reproductive systems. The esophagus leads into the **crop**, a thin-walled sac that holds soil before it is passed to the **gizzard**. The thick-walled gizzard grinds the organic matter or food into small pieces, so that the nutrients can be absorbed as they pass through the **intestine**. The dorsal fold and constrictions of the intestine increase its surface for secretion and absorption. Undigested food and any remaining soil are eliminated through the **anus**.

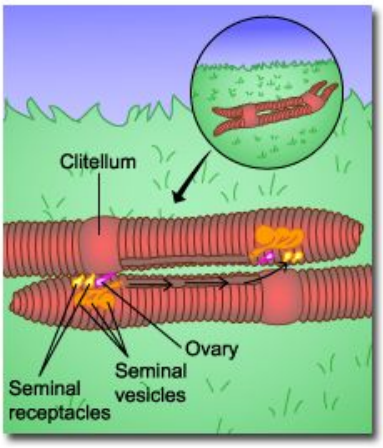


The **simple brain** is located on the dorsal surface of the pharynx. It consists of two tiny masses that coordinate the **nerve fibers** of the earthworm. In order to see the ventral nerve cord, the digestive tract has to be carefully removed. The ventral nerve cord consists of a chain of **ganglia** and three pairs of **nerves** in each segment.



Nephridia are excretory structures that collect waste products and transport them out of the body. They lie to the left and right of the intestinal tract in many of the earthworm's segments. Each white-colored nephridium consists of a looped channel. The nephridium begins with a ciliated funnel in the preceding segment's cavity and ends with the excretory opening on the surface of the earthworm.

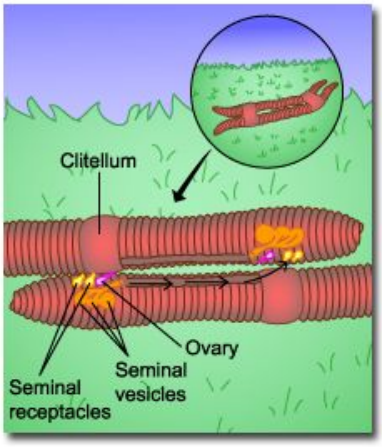
Reproductive System



The earthworm is a hermaphrodite. Its complex reproductive system consists of both male and female parts. Upon opening the body wall of the earthworm, the three pairs of yellow-white bladders above the esophagus are visible. These are the **seminal vesicles** in which the sperm mature. Bycarefully removing the esophagus and the bloodvessels, the full extent of the reproductive organs can be seen. The small **testes** are inside the seminal vesicles. The testes can be seen by cutting an opening in the seminal vesicle and turning the vesicle inside out. **Sperm ducts** lead from the seminal vesicles to the sperm duct openings on the surface of segment fifteen.

Page 8

Reproductive System

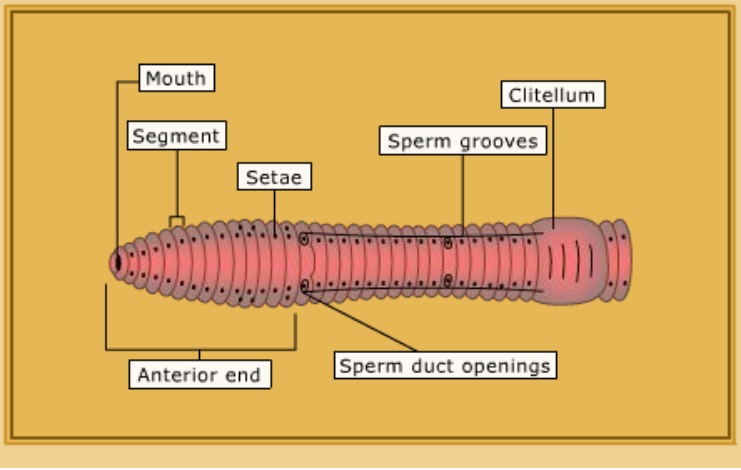


The **seminal receptacles** are small, white spheres in segments 9 and 10. These receptacles store sperm received from another worm.

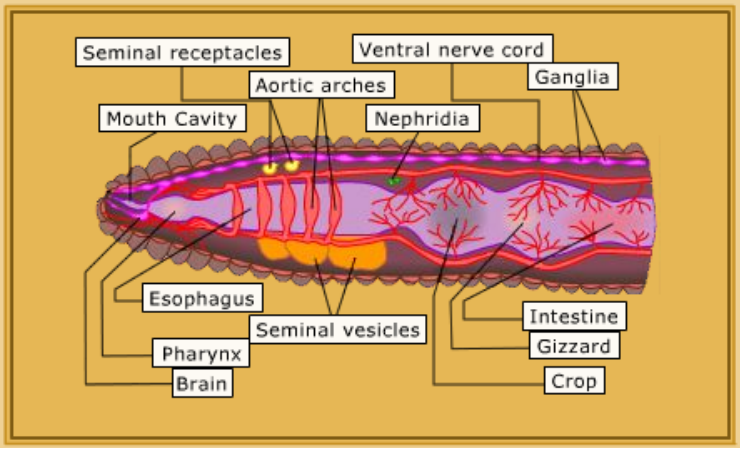
The **ovaries** are small, white conical-shaped organs. They are attached to the partition between segment twelve and thirteen. The wall between segment thirteen and fourteen forms an **egg sac**, where the eggs are stored. The **oviducts** start in the egg sac and open on the surface of segment fourteen.

Page 9

External anatomy | **Internal anatomy**



External anatomy | Internal anatomy



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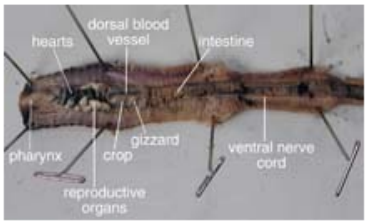
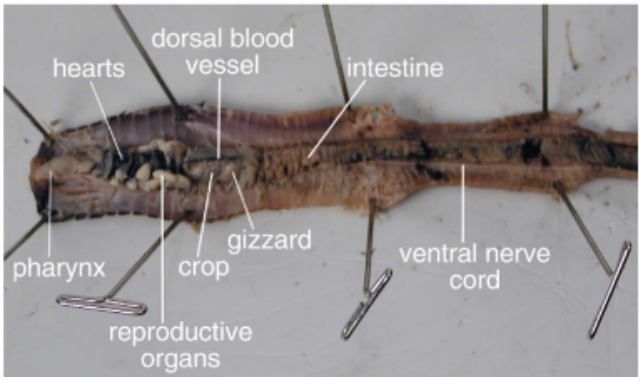
Look at the labeled picture to help you find the following features:



Click for full-size pdf

- **Pharynx**: This is the light-colored organ just inside the mouth. Its muscular contractions pass food on down to the esophagus.
- **Hearts** (or "aortic arches"): Behind the pharynx are five dark loops wrapped around the esophagus. These are the blood vessels that serve as the hearts of the worm.
- **Dorsal blood vessel:** This is a dark line extending from the hearts over the top of the crop.
- **Crop:** Food from the esophagus is temporarily stored in the crop.
- **Gizzard:** Food comes from the crop into the gizzard, where it is ground up.
- **Intestine:** The intestine is the long tube extending from the gizzard all the way to the anus. Food is digested and absorbed here.
- **Reproductive organs:** The light colored tissue above and around the hearts are *seminal vesicles*. Other reproductive parts appear as small white organs on the ventral side of the hearts.
- **Ventral Nerve Cord:** With your forceps, gently push aside the intestine to view the long white nerve cord running along the length of the worm beneath it.



Introduction to the Arthropods

Chapter 28: Section 28-1
Page 715

Arthropods are the most diverse and successful animals of all time.

At least three quarters of a million species have been identified - more than three times the number of all other animal species combined.

They include insects, crabs, centipedes and spiders.

Dec 7-11:25 PM

Arthropods have a segmented body, a tough exoskeleton and jointed appendages.

The exoskeleton protects and supports the body. It is made from chitin. It varies greatly in size, shape and toughness.

caterpillars -> firm and leathery
lobsters -> so tough and hard it is difficult to crush by hand

Exoskeletons of many terrestrial species have a waxy covering that helps the loss of water.

Appendages are structures that extend from the body wall. Jointed appendages are so distinctive of arthropods that the phylum is named for them:

arthron means "joint" in Greek and *podos* means "foot"

Appendages include antennae, claws, walking legs, wings, flippers, mouthparts, tails and other specialized features.

Evolution of Arthropods

Page 716

The evolution of arthropods, by natural selection and other processes, has led to fewer body segments and highly specialized appendages for feeding, movement and other functions.

natural selection: process by which individuals that are better suited to their environment survive and reproduce most successfully

Glossary.

Form and Function in Arthropods

(Page 716)

Feeding

Arthropods include herbivores, carnivores, omnivores and detritivores.

detritivore - organism that feeds on plant and animal remains and other dead matter

There are arthropod bloodsuckers, filter feeders (feed by straining food particles from water) and parasites.

mosquito

krill

tick

Arthropod mouthparts have evolved in ways that enable different species to eat almost any food you can imagine.

Respiration

Most terrestrial arthropods breathe through a network of branching tracheal tubes that extend throughout the body. Air enters and leaves the tracheal tubes through spiracles, small opening along the side of the body.

Other terrestrial arthropods like spiders use book lungs, layers of respiratory tissue stacked like the pages of a book.

Most aquatic arthropods (lobsters and crabs) respire through featherlike gills. Horseshoe crabs respire through book gills.

Aquatic

Circulation

Arthropods have an open circulatory system. Blood leaves the blood vessels and collects in a large sinus surrounding the heart. From there, it re-enters the heart and gets pumped through the body again.

Excretion

Most terrestrial arthropods such as insects and spiders dispose of nitrogenous wastes using Malpighian tubules - saclike organs that extract wastes from the blood and add them to feces that move through the gut.

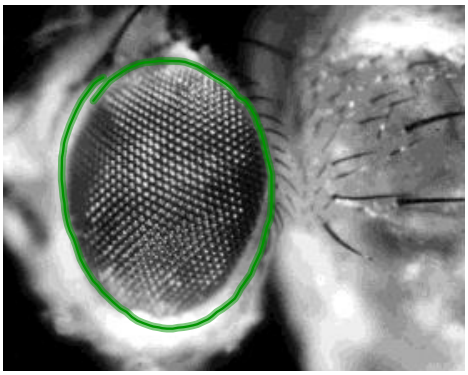
In aquatic arthropods, diffusion moves cellular waste from the body into the surounding water.

Response

Most arthropods have a well-developed nervous system.

All have brains. Two nerves that encircle the esophagus connect the brain to a ventral nerve cord. Along the nerve cord are several ganglia. They coordinate the movements of individual legs and wings.

Most have sophisticated sense organs such as compound eyes that may have more than 2000 separate lenses that can detect color and motion very well.



Dec 8-12:56 AM

Movement

Arthropods move using well-developed groups of muscles that are coordinated and controlled by the nervous system. Muscles are made up of individual cells. At each joint, different muscles either flex (bend) or extend (straighten) the joint.

Page 718

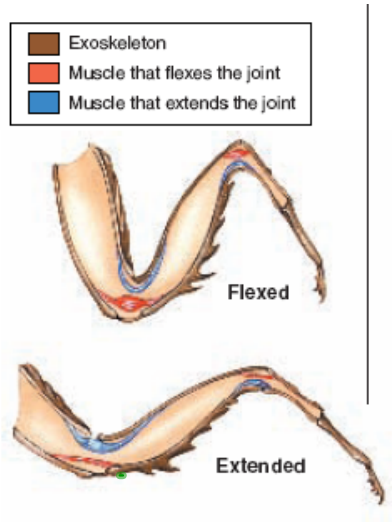


Figure 28–5 This diagrammatic representation shows how muscles attached to the exoskeleton bend and straighten the joints. (Actual muscles are much larger than those shown here.)

The pull of muscles against the exoskeleton allows arthropods to beat their wings against the air to fly, push their legs against the ground to walk or beat their flippers against the water to swim.

Reproduction

Terrestrial arthropods have internal fertilization.

Aquatic arthropods may have internal or external fertilization.

Growth and Development

When arthropods outgrow their exoskeletons, they undergo periods of molting. During molting, an arthropod sheds its entire exoskeleton and manufactures a larger one to take its place.

▲ **Figure 28–6** When they become too large for their exoskeletons, arthropods undergo periods of molting. This cicada has just molted and is climbing out of its old exoskeleton.

Page 719

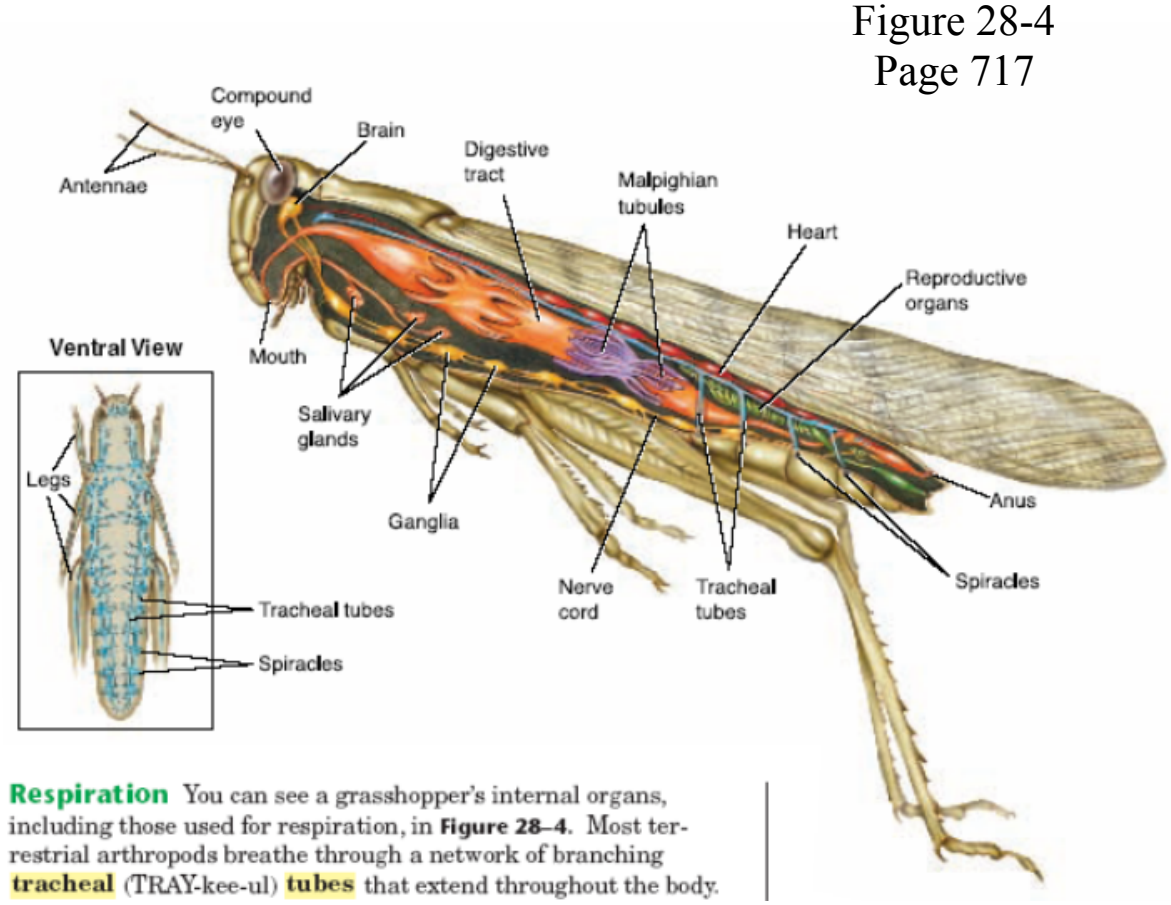
Skin glands digest the inner part of the exoskeleton and other glands secrete a new exoskeleton. When the new skeleton is ready, the animal pulls itself out of what remains of the original skeleton. The process can take several hours. While the new exoskeleton is still soft, the animal fills with air or fluids to allow room for growth before the next molting. Most arthropods molt several times between hatching and adulthood. The arthropods are vulnerable to predators during this process. Animals typically hide during molting or molt at night.

Molting - Horseshoe Crab

Dec 8-1:12 AM

The grasshopper has organ systems typical of most arthropods.

Figure 28-4
Page 717



Respiration You can see a grasshopper's internal organs, including those used for respiration, in **Figure 28–4**. Most terrestrial arthropods breathe through a network of branching **tracheal** (TRAY-kee-ul) **tubes** that extend throughout the body.

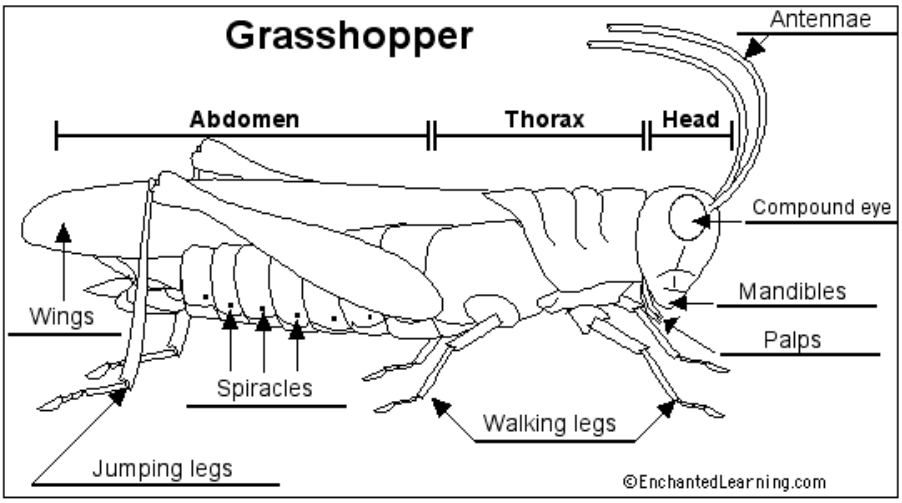
Grasshopper Dissection

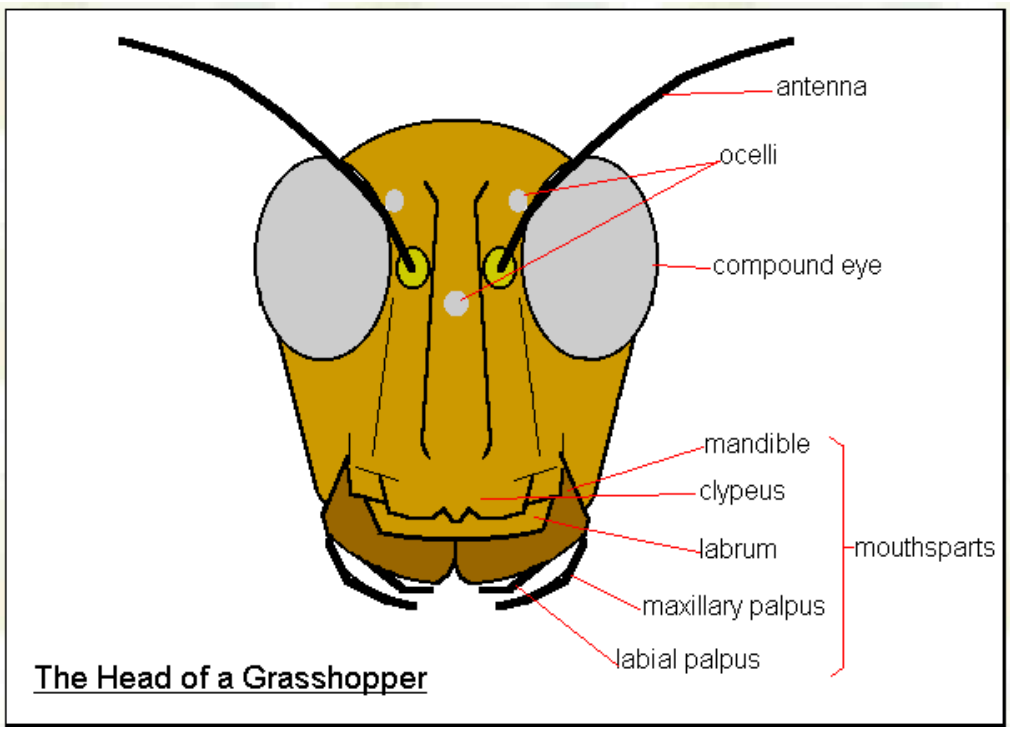
Diagrams

Dec 8-1:45 AM

abdomen - the segmented tail area of a grasshopper, which contains the heart, reproductive organs, and most of the digestive system
antennae - like all insects, grasshoppers have 2 segmented antennae that sense touch and odors
compound eye - grasshoppers have 2 faceted eyes made up of many hexagonal lenses
head - the head is at the front end of the grasshopper's body and is the location of the brain, the two compound eyes, the mouth parts, and the points of attachment of its two antennae.
jumping legs -the long, hindmost pair of the grasshopper's six legs
mandibles - the jaws, located near the tip of the head, by the palps; the jaws crush the food

palps - long, segmented mouth parts (under the jaws) that grasp the food
spiracles - a series of holes located along both sides of the abdomen; they are used for breathing
thorax - the middle area of the grasshopper's body - where the legs and wings are attached
walking legs - the four, short front legs that are used for walking
wings - grasshoppers have two long wings, used for flying.



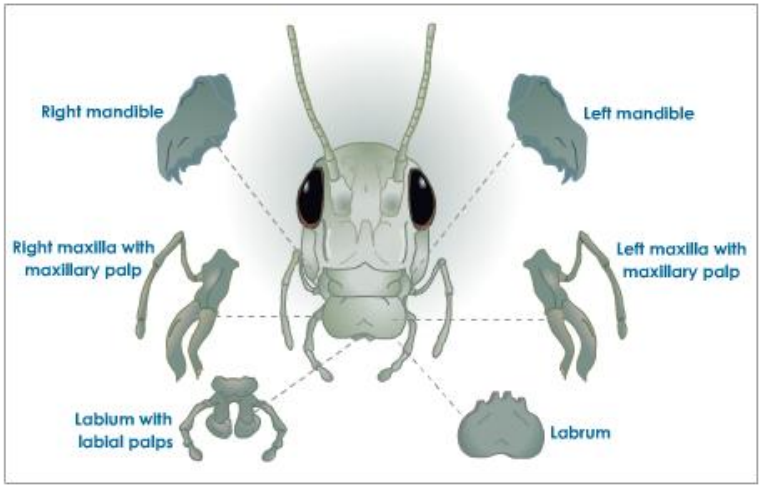


The Head of a Grasshopper

Dec 8-10:44 PM

To understand the position of the mouth parts, observe the external features of a grasshopper in this diagram.

The body of the grasshopper is segmented into three portions head, thorax and the abdomen. The mouth parts are attached to the ventral side (underside) of the head portion and surrounds the mouth or the oral cavity which faces down.



Grasshopper - Mouthparts

The different mouthparts are:

Labrum or the upper lip

It is a broad, roughly rectangular shaped structure.

Lingua or the hypopharynx

A membranous tongue-like structure found attached beneath the labrum.

Mandibles

A pair of hard, horny, heavy, large, with jagged inner edges and dark coloured triangular structures found one on either side. The two mandibles move in horizontal motion and crush food between them.

Maxillae

A pair of structures lying outside and behind the mandibles. Each of them consist of 5-segmented sensory maxillary palp in addition to other parts. The maxillae are used to manipulate the food before it enters the mouth.

Labium

Forms the broad median lower lip consisting of several parts in addition to a pair of 3-segmented labial palps on either side.

The maxillary and labial palps have sense organs which help them to chose a suitable vegetation.

The mandibles and the maxillae grind the food by moving it laterally.

The labrum and labium help to hold the food between the mandibles and the maxillae.

Groups of Arthropods

Section 28-2
Page 720-725

Handout - Section 28-2
Page 720-725

Dec 11-1:06 AM

Name_____ Class_____ Date_____

Section 28–2 Groups of Arthropods

(pages 720–725)

Key Concepts

- How are arthropods classified?
- What are the distinguishing features of the three major groups of arthropods?

Introduction (page 720)

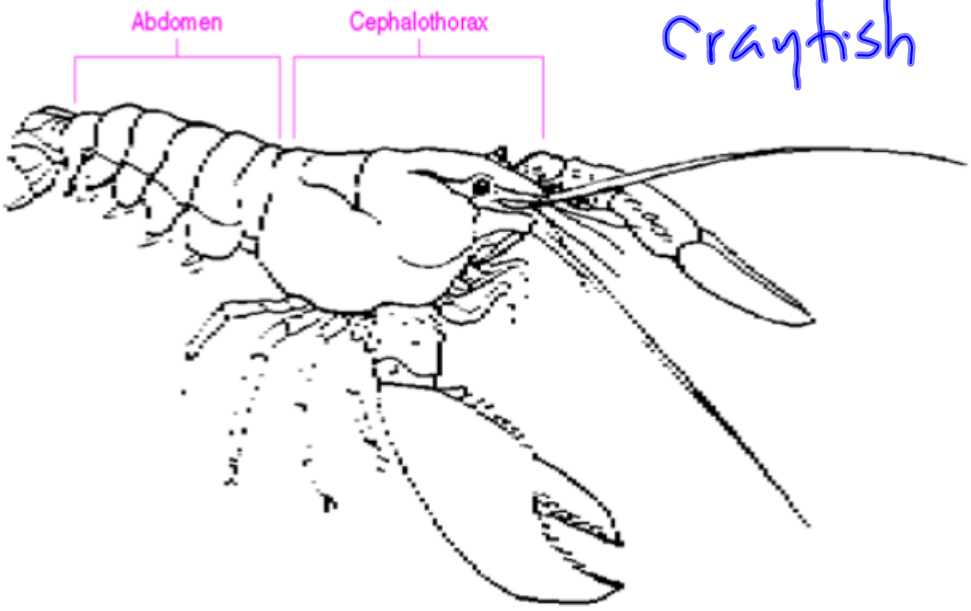
1. What characteristics do biologists use to classify arthropods? Arthropods are classified based on the number and structure of their body segments and appendages—particularly their mouthparts.

2. What are the three major groups of arthropods?
   a. Crustaceans
   b. Spiders and their relatives
   c. Insects and their relatives

Crustaceans (pages 720–721)

3. Circle the letter of each description of structures that crustaceans typically have.
   a. two pairs of branched antennae
   b. four or five body sections
   c. chewing mouthparts called mandibles
   d. two or three body sections

4. Label the two body sections of a typical crustacean.



Crayfish

Name_____ Class_____ Date _____

5. The largest group of crustaceans is the decapods.
6. Complete the table about crustacean body parts.

CRUSTACEAN BODY PARTS

Body Part	Description
Thorax	Section just behind the head that houses most of the internal organs
Cephalothorax	Fusion of the head with the thorax
Abdomen	The posterior part of the body
Carapace	The part of the exoskeleton that covers the cephalothorax
Mandible	A mouthpart adapted to biting and grinding food
Chelipeds	First pair of legs in decapods, which bear large claws
Swimmerets	Flipperlike appendages used for swimming

7. Circle the letter of each sentence that is true about barnacles.
   - (a.) They are sessile. → staying in one spot
   - (b.) They have an outer, shell-like covering.
   - c. They move backward by snapping a tail.
   - (d.) They attach themselves to rocks and marine animals.

Spiders and Their Relatives (pages 722–724)

8. Horseshoe crabs, spiders, ticks, and scorpions are grouped as chelicerates.
9. Circle the letter of each description of structures that chelicerates have.
   - (a.) four or five pairs of legs
   - b. three or four body sections
   - c. two pairs of branched antennae
   - (d.) mouthparts called chelicerae
10. What is the function of the chelicerae? Chelicerae contain fangs and are used to stab and paralyze prey.
11. The appendages near the mouth that are usually modified to grab prey are called pedipalps.
12. How do spiders respire? Air enters through spiracles and then circulates across the surfaces of the book lung.

Name_____ Class_____ Date _____

13. What arthropods do arachnids include? They include spiders, mites, ticks, and scorpions.

14. How are horseshoe crabs like and unlike crabs? They are heavily armored like crabs, but they have an anatomy closer to that of spiders.

15. Why must spiders liquefy their food to swallow it? Spiders do not have jaws for chewing.

16. Circle the letter of each sentence that is true about spiders and silk.
   a. Spiders spin silk into cocoons for eggs.
   b. Spinning webs seems to be a programmed behavior.
   c. Spinnerets are organs that contain silk glands.
   d. Tarantulas cannot produce silk.

17. Is the following sentence true or false? Mites and ticks are often parasitic.
   true

18. Scorpions have pedipalps that are enlarged into claws.

19. What do ticks transmit that cause Rocky Mountain spotted fever and Lyme disease?
   They carry bacteria that cause these diseases.

Insects and Their Relatives (page 725)

20. Centipedes, millipedes, and insects are all grouped as uniramians.

21. Circle the letter of each description of structures that uniramians have.
   a. one pair of antennae
   b. unbranched appendages
   c. mouthparts called chelicerae
   d. jaws

22. Why are centipedes restricted to moist or humid areas? Their spiracles cannot close, and they lack a waterproof coating on their exoskeleton. As a result, their bodies lose water easily.

23. How many pairs of legs does each body segment of most centipedes have? Most body segments of centipedes bear one pair of legs each.

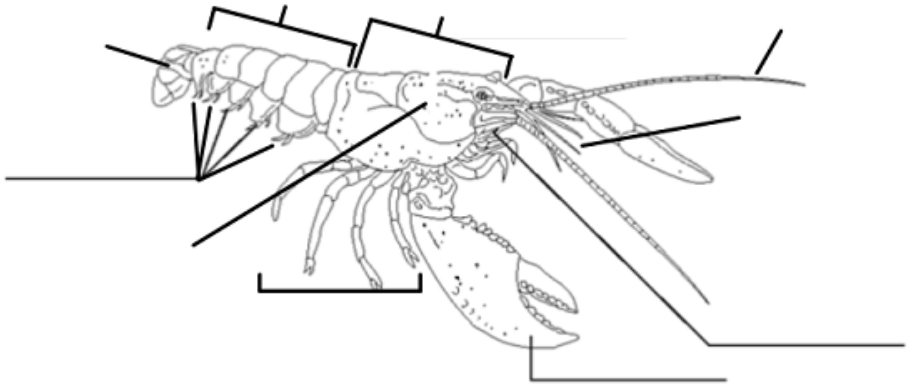
24. How many pairs per segment do millipedes have?
   Each millipede segment bears two pairs of legs.

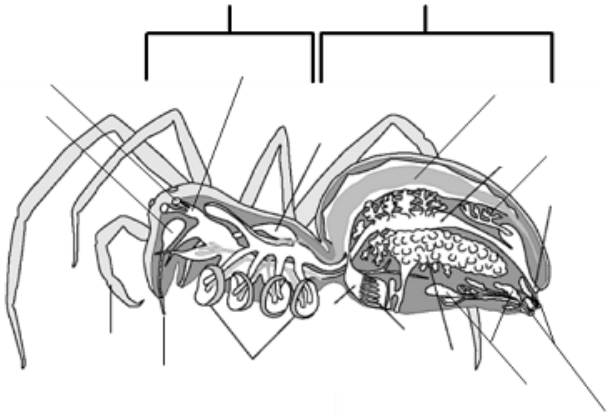
Biology 112
Arthropods
Compare/Contrast Table

Phylum - _____

Subphylum			
Group			
Antennae			
Number of Body Sections			
Mouthparts			
Examples			

Dec 13-3:51 PM





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Biology 112
Arthropods
Compare/Contrast Table

Phylum - Arthropoda

Subphylum	Crustacea	Chelicerata	Uniramia
Group name	crustaceans	chelicerates	uniramians
Antennae	four (two pairs)	none	two (one pair)
Number of Body Sections	two or three	two	varied
Mouthparts	mandibles	chelicerae pedipalps	jaws
Examples →	crayfish, crab, shrimp, lobster, barnacle →	spider, horseshoe crab, tick	centipedes, millipedes, insects }

Dec 13-3:52 PM

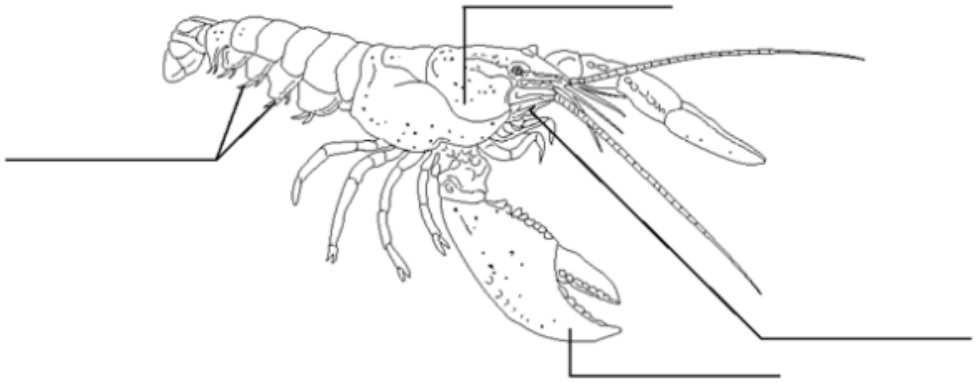
Name_____ Class_____ Date _____

Crustacean Anatomy

The crayfish shown is one example of a crustacean. Most crustaceans have similar body organization and body structures.

Color the tail section red. Color the abdomen blue. Color the cephalothorax yellow. Then use the words below to label the diagram.

carapace	cheliped	mandible	swimmerets



Use the diagram to answer the questions.

1. In what section is the carapace located? Circle the correct answer.

   abdomen cephalothorax

2. What structure does the crustacean use to catch and crush food?

   _____

3. For what does the crustacean shown use its swimmerets?

   _____

4. What does the crustacean shown use to bite and grind food? Circle the correct answer.

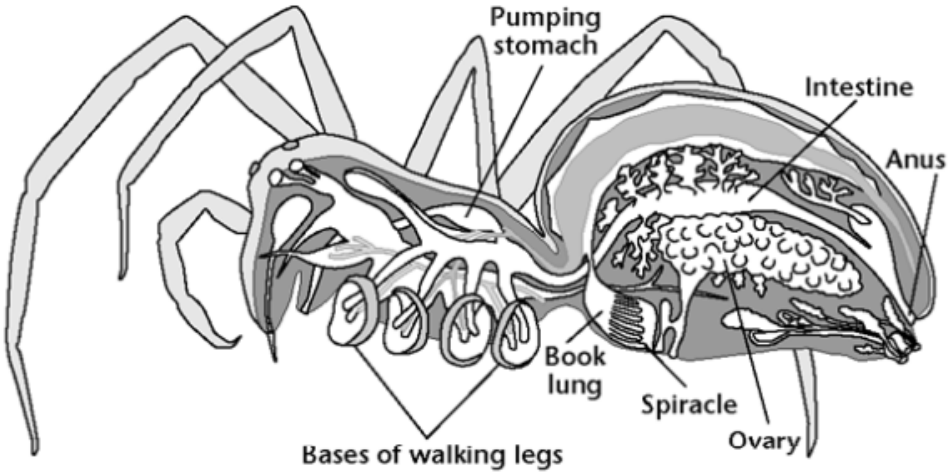
   mandible abdomen

Name_____ Class_____ Date _____

Spider Anatomy

Follow the prompts to identify the spider's body systems. The circulatory system is shaded for you.

- Color the structures in the digestive system green.
- Color the structures in the respiratory system blue.
- Color the structures in the reproductive system red.



Use the diagram to answer the questions.

1. Which organ is part of the respiratory system? Circle the correct answer.

   spinneret spiracle

2. What does a spider use its chelicerae for?

   _____

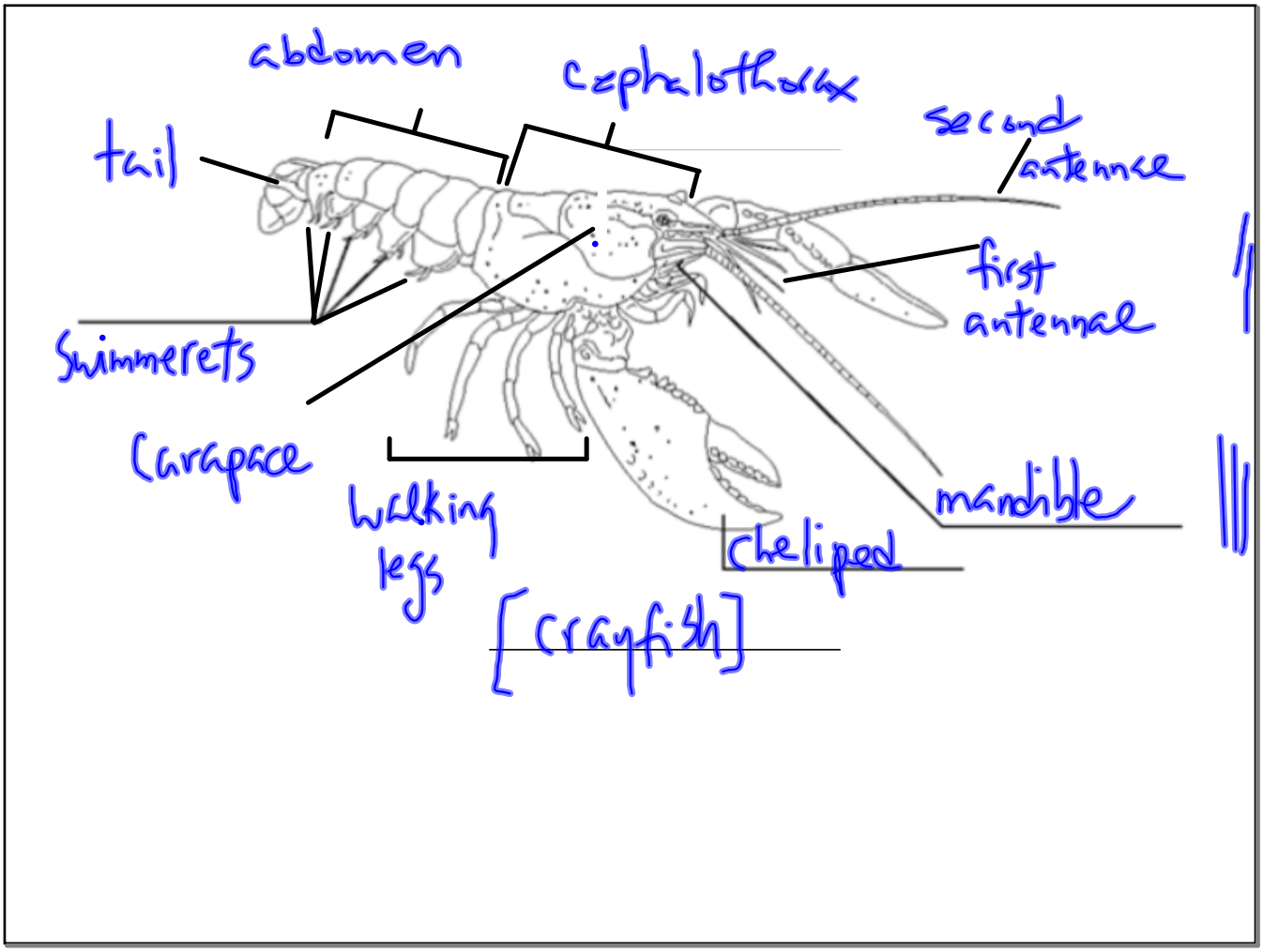
3. What labeled organs does a spider use for digestion?

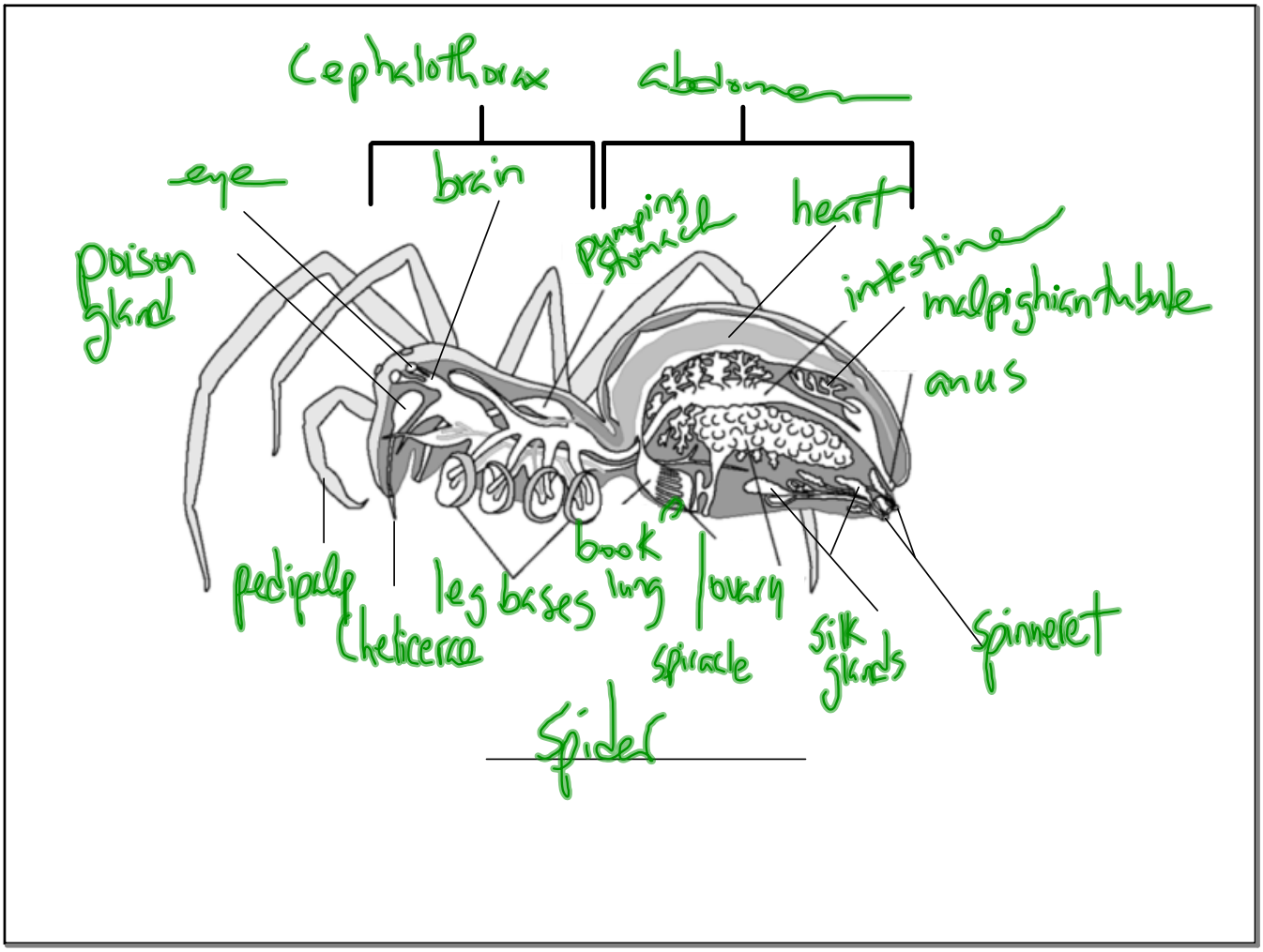
   _____

4. Can spiders chew their prey? Explain.

   _____

   _____


abdomen
cephalothorax
tail
second antennae
first antennae
swimmerets
carapace
walking legs
mandible
cheliped
[crayfish]


Cephalothorax
abdomen
eye
brain
pumping stomach
heart
Poison gland
intestine
malpighian tubule
anus
book lung
ovary
pedipalp
leg bases
chelicerae
spiracle
silk glands
spinneret
Spider

Dec 13-3:23 PM

Review for Friday

Animal Kingdom

- invertebrate
- vertebrate
- zygote
- embryology
- blastula
- blastopore
- protostome
- deuterostome
- germ layers (endoderm, mesoderm, ectoderm)
- Coelom
- radial and bilateral symmetry
- anterior, posterior, dorsal, ventral, lateral
- segmentation
- homeostasis
- intracellular and extracellular digestion
- crop, gizzard
- open and closed circulatory systems
- nephridia
- Malpighian tubules
- hydroskeleton, exoskeleton, endoskeleton
- hermaphrodite (worm)
- ganglia
- cephalization

Dec 15-8:52 AM

May 22/12 Review Questions

1. What are the three stages of cellular respiration, where do they occur and what are the products of each?

I. glycolysis
→ cytoplasm of cell
→ 2 pyruvic acid
2 ATP
2 NADH
→ start: glucose

II. Krebs cycle
→ matrix of mitochondria
→ 1 ATP
→ 4 NADH
→ 1 $FADH_2$
→ 3 CO_2
→ pyruvic acid

III electron transport
→ inner membrane of mitochondrion
→ 2 NAD^+
1 FAD
NADH
$FADH_2$ ⇒
1 ATP
water

→ NADH, $FADH_2$

overall reaction:

$C_6H_{12}O_6 + 6O_2 \rightarrow 6H_2O + 6CO_2$ + energy

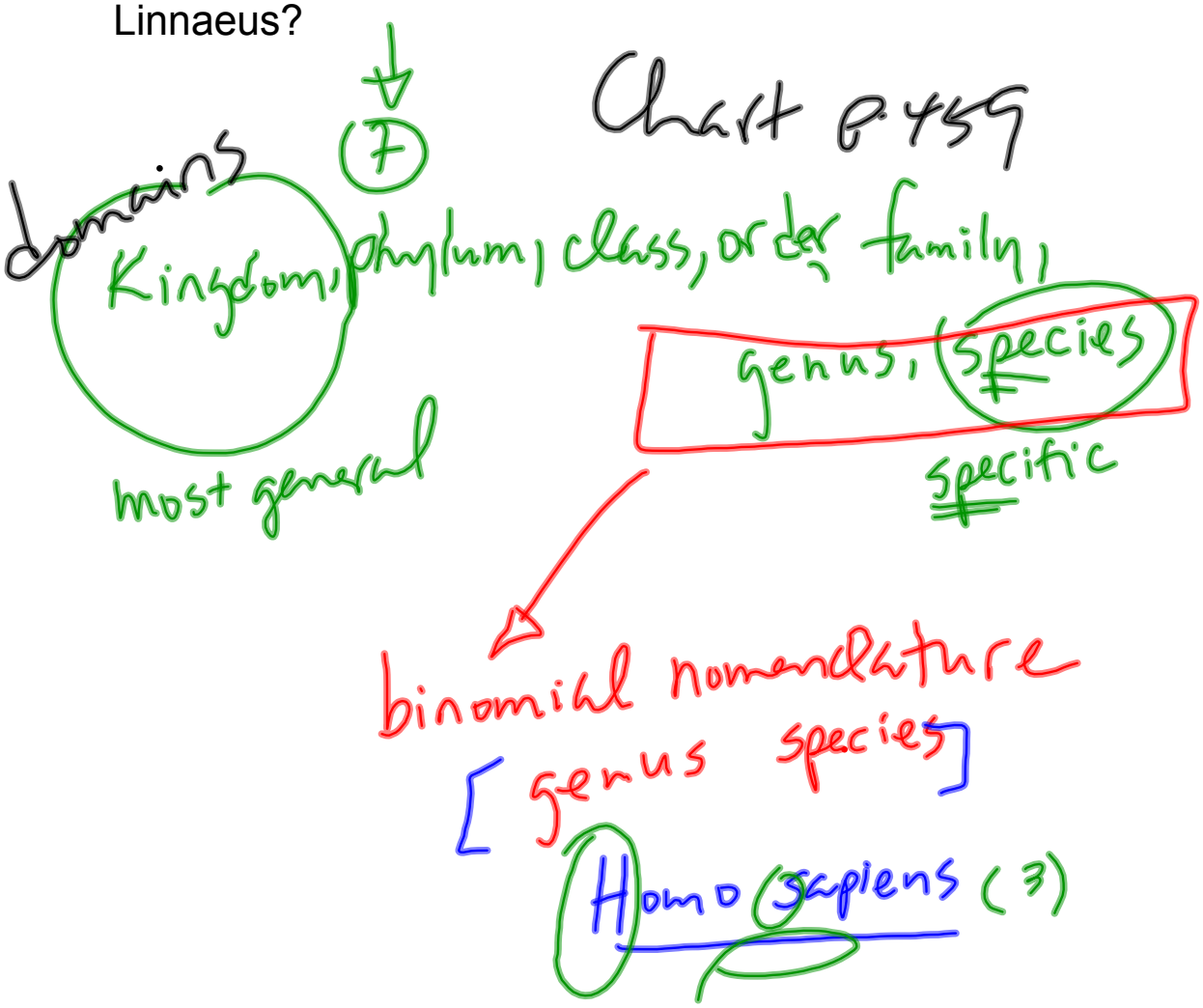
glycolysis aerobic

$6H_2O$ → III
$6CO_2$ → II
energy → I, II, III

May 22-3:40 AM

May 23/12

2. What are the levels of taxonomy in the system created by Linnaeus?



May 24/12

3. a) What are the four plant phyla we studied?

   b) What are the characteristic features of the plants in the phyla we studied?

May 23-9:48 AM

The Chordates

Chapter 30: Nonvertebrate Chordates, Fishes and Amphibians
Page 767-770

Phylum - Chordata

Four Characteristics

A chordate is an animal that has for at least some stage of its life, a dorsal, hollow nerve cord; a notochord; pharyngeal pouches; and a tail that extends beyond the anus.

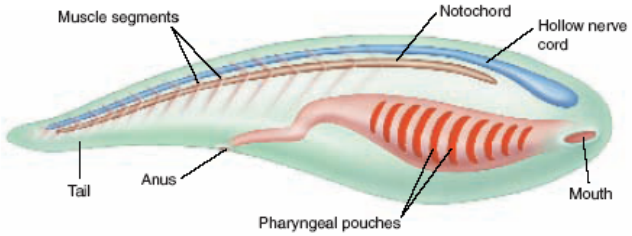


Figure 30–1 All chordates share four characteristics: a dorsal, hollow nerve cord; a notochord; pharyngeal pouches; and a tail that extends beyond the anus. Some chordates possess all these characteristics as adults; others possess them only as embryos.

Page 767

Nerves branch from the nerve cord at regular intervals and connect to organs, muscles and sense organs.

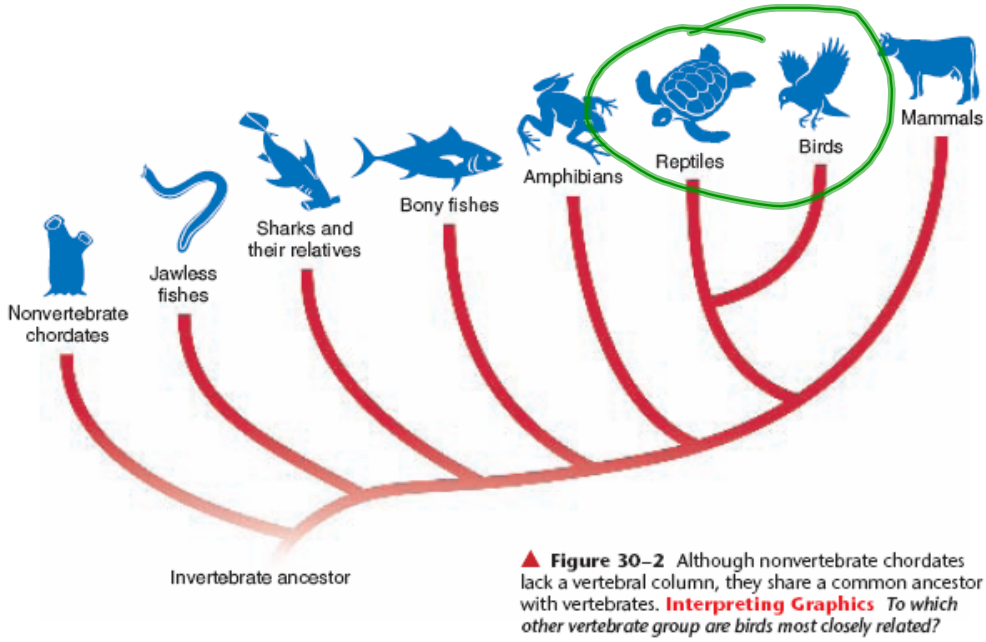
The notochord is a long supporting rod that runs through the body just below the nerve cord. Most chordates have a notochord only when they are embryos.

Pharyngeal pouches are paired structures in the throat (pharynx) region.

The tail can contain bone and muscle and is used in swimming in many aquatic species.

Phylogeny of Chordates

(Page 768)



▲ **Figure 30–2** Although nonvertebrate chordates lack a vertebral column, they share a common ancestor with vertebrates. **Interpreting Graphics** *To which other vertebrate group are birds most closely related?*

About 96% of all chordate species are placed in the subphylum Vertebrata and are called vertebrates. Most vertebrates have a strong supporting structure known as a vertebral column or backbone.

. dorsal, hollow nerve cord -> the spinal cord

As the vertebrate embryo develops, the front end of the spinal cord develops into a brain.

notochord -> replaced by the backbone in most developing vertebrates

-> the backbone is made of individual segments called vertebrae

-> the backbone is part of an endoskeleton that supports and protects an animal's body and gives a place for muscles to attach

-> the backbone grows as the animal grows

There are two subphyla of chordates that do not have backbones.

Tunicates (subphylum Urochordata) and lancelets (subphylum Cephalochordata) are soft-bodied marine organisms.

They have a hollow nerve cord, a notochord, pharyngeal pouches and a tail at some point in their life cycle.

Figure 30–4 Tunicates get their name from the adult's body covering—the tough, nonliving tunic. Most tunicates are commonly known as sea squirts, because of the stream of water they sometimes eject. **Inferring** *In what kind of ecosystem are you likely to find tunicates?*

Figure 30–5 Lancelets are small nonvertebrate chordates that often live with their bodies half buried in sand. Because lancelets do not have fins or legs, they can move only by contracting the paired muscles on their bodies. **Interpreting Graphics** *Which chordate characteristics do lancelets have?*

Chapter 33: Comparing Chordates

Page 848

Evolutionary Trends in Vertebrates

Page 851

Over the course of evolution, the appearance of new adaptations (ie/ jaws, paired appendages) has launched adaptive radiations in chordate groups.

adaptive radiation - the rapid diversification of species as they adapt to new conditions

Convergent evolution is the process by which unrelated organisms independently evolve similarities when adapting to similar environments.

The six living groups of chordates are the nonvertebrate chordates (tunicates and lancelets), fishes, amphibians, reptiles, birds and mammals.

Page 852

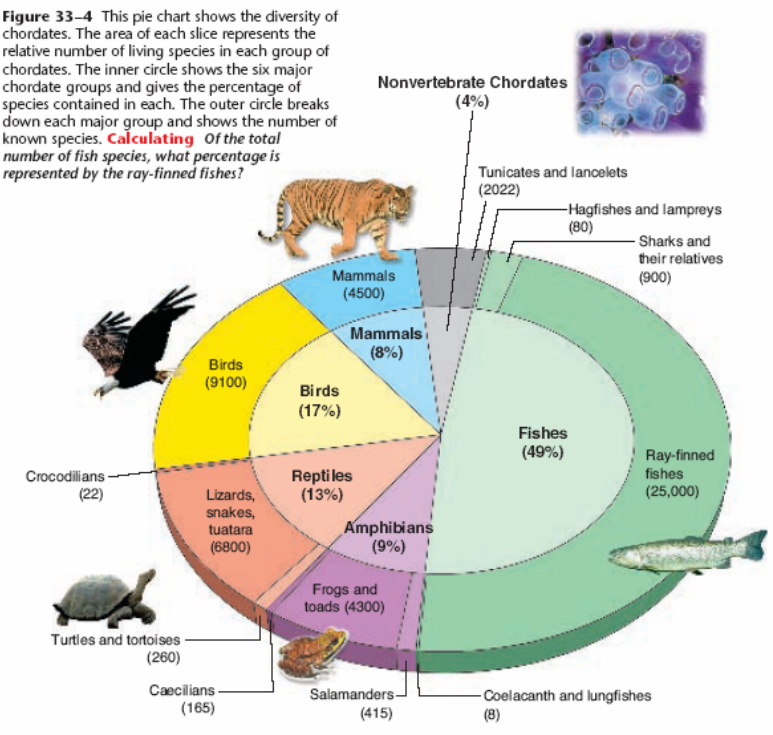


Figure 33–4 This pie chart shows the diversity of chordates. The area of each slice represents the relative number of living species in each group of chordates. The inner circle shows the six major chordate groups and gives the percentage of species contained in each. The outer circle breaks down each major group and shows the number of known species. **Calculating** *Of the total number of fish species, what percentage is represented by the ray-finned fishes?*

Fishes are aquatic vertebrates; most fishes have paired fins, scales and gills.

An amphibian is a vertebrate that, with some exceptions, lives in water as a larva and on land as an adult, breathes with lungs as an adult, has moist skin that contains mucous glands, and lacks scales and claws.

A reptile is a vertebrate that has dry scaly skin, lungs and terrestrial eggs with several membranes.

Birds are reptile-like animals that maintain a constant internal body temperature. They have an outer covering of feathers; two legs that are covered with scales and are usd for walking or perching; and front limbs modified into wings.

In addition to having hair and the ability to nourish their young with milk, all mammals breathe air, have four-chambered hearts, and are endotherms that generate their body heat internally.

Dec 14-11:34 PM

Controlling Body Temperature

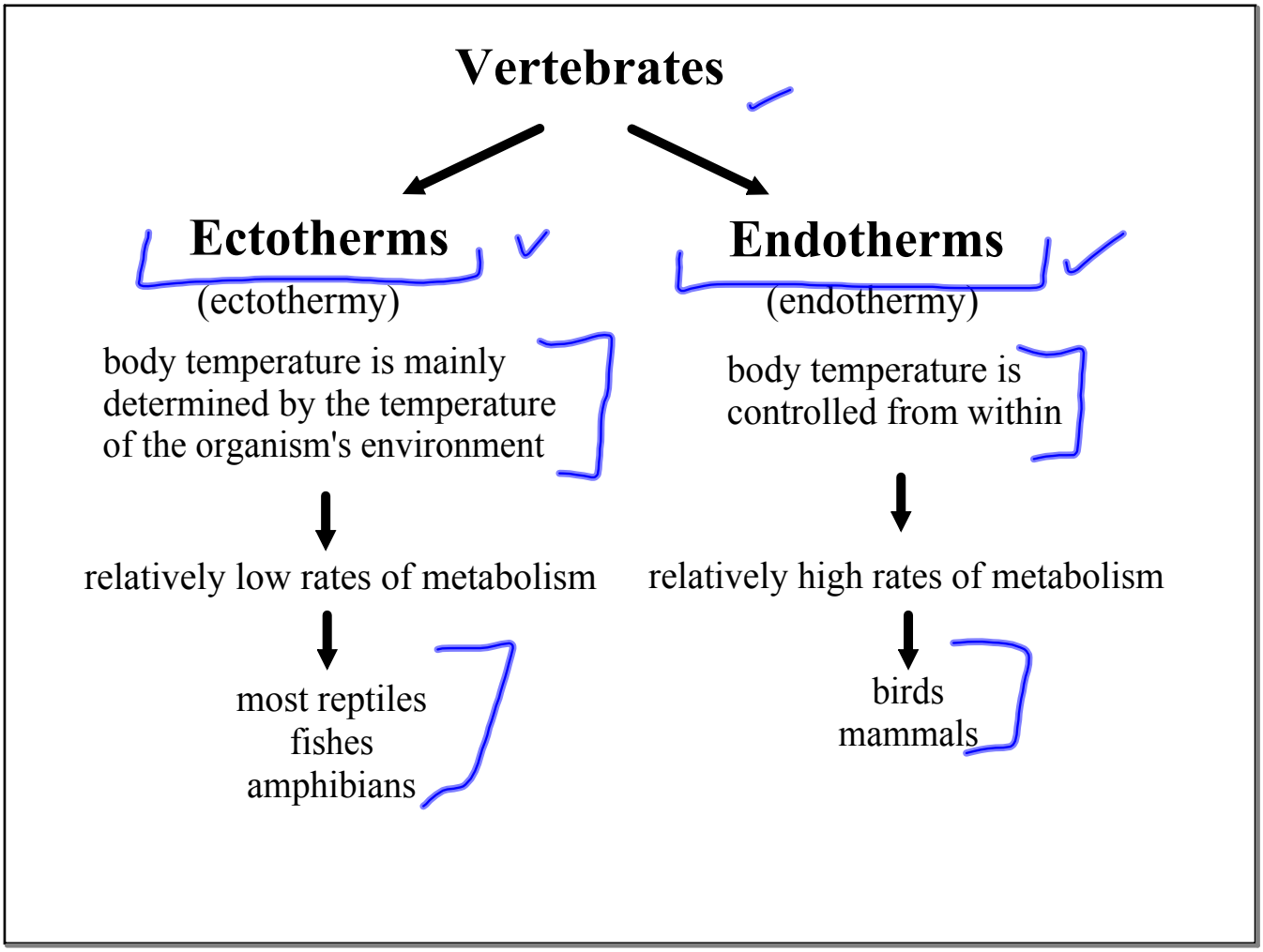
(Page 854)

The controlling of body temperature is important for maintaining homeostasis in vertebrates, particularly in habitats where temperature varies widely with time of day and season.

All of the ways vertebrates control their body temperatures incorporate three inportant features:

1. a source of heat for the body
2. a way to conserve that heat
3. a method of eliminating excess heat when necessary

Dec 14-11:38 PM



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Form and Function in Chordates

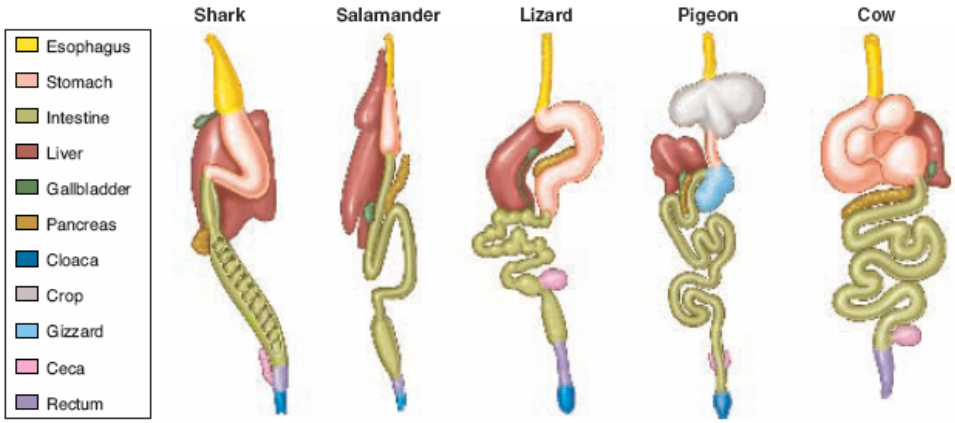
Page 857

Vertebrates have organ systems that exhibit a wider range of complexity than those of nonvertebrates.

Feeding

Feeding and digestion help maintain homestasis by providing the body with a continuing supply of needed nutrients.

The digestive systems of vertebrates have organs that are well adapted for different feeding habits.



▲ **Figure 33–8** The digestive systems of vertebrates are adapted for a variety of feeding modes. As you can see, these systems differ in their degree of complexity.

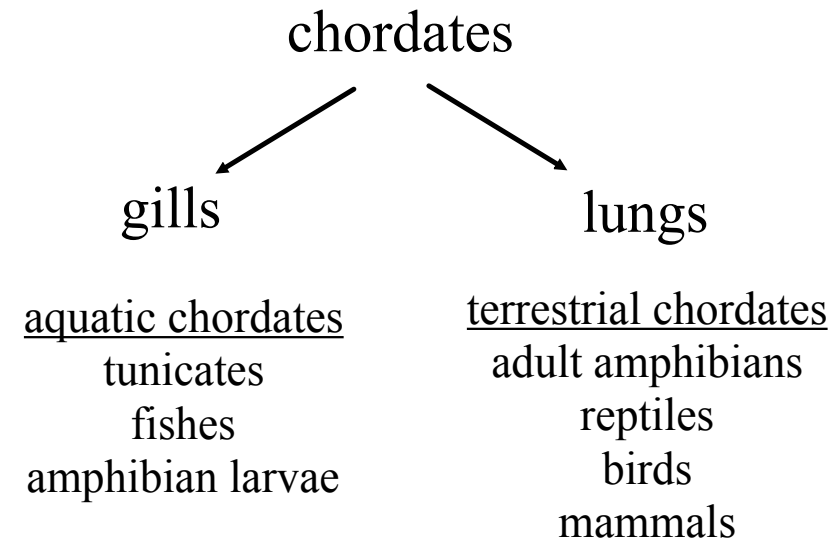
Page 859

cloaca - a muscular cavity at the end of the large intestine through which digestive wastes, urine and eggs or sperm leave the body

ceca (singular:cecum) - fingerlike pouches where food may be further digested

Dec. 15/09

Respiration



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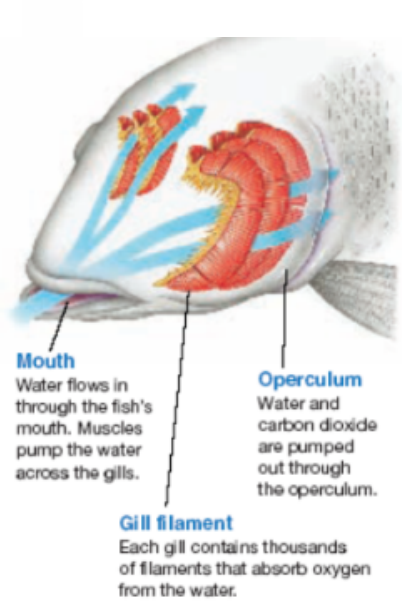
Gills Page 859

Figure 33–9 Fishes and many other aquatic chordates use gills for respiration. **Interpreting Graphics** *Describe the path of water as it flows into and out of the fish.*



mouth → gills → operculum

operculum - a protective bony cover

Lungs

Inhaling brings oxygen-rich air from outside the body through the trachea and into the lungs. The oxygen diffuses into the blood inside the lung capillaries. At the same time carbon dioxide diffuses out of the capillaries. Oxygen-poor air is then exhaled.

amphibians ----------> mammals

surface area of lungs increases

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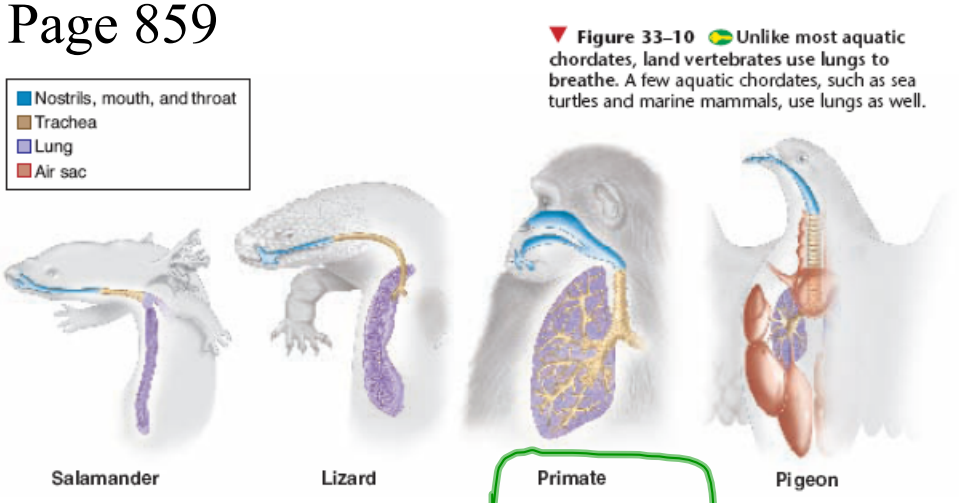

Figure 33–10 Unlike most aquatic chordates, land vertebrates use lungs to breathe. A few aquatic chordates, such as sea turtles and marine mammals, use lungs as well.

Salamander	Lizard	Primate	Pigeon
a sac with ridges	a series of large and small chambers	lungs branch extensively - air moves in and out through the same passageways - alveoli	air flows in only one direction - system of tubes and air sacs

alveoli (singular: alveolus) - bubble-like structures
- provide an enormous surface area for gas exchange

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Circulation

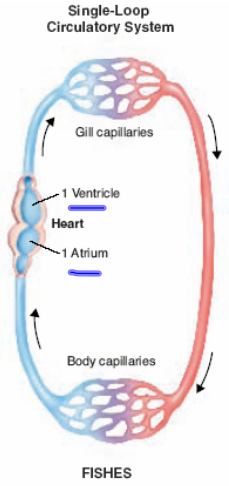
Circulatory systems maintain homeostasis by transporting materials throughout the bodies of animals.

Tunicates have short, tubelike hearts with a simple pump but no true chambers.

Lancelets have a fairly well-developed circulatory system but no specialized heart.

Vertebrates that use gills for respiration have a single-loop circulatory system. In this system, blood travels from the heart to the gills, then to the rest of the body, and then back to the heart in one circuit.

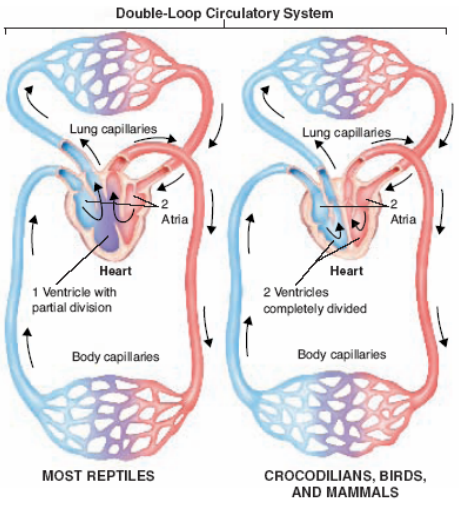
Figure 33-11
Page 860



chambers
atrium
↳ "receiving"
ventricle
↳ "shipping"

Vertebrates that use lungs for respiration have a double-loop circulatory system. The first loop carries blood between the heart and lungs. Oxygen-poor blood from the heart is pumped to the lungs, while oxygen-rich blood from the lungs returns to the heart. The second loop carries blood between the heart and the body. Oxygen-rich blood from the the heart is pumped to the body while oxygen-poor blood from the body returns to the heart.

Figure 33-11
Page 860



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During the course of chordate evolution, the heart developed chambers and partitions that help separate oxygen-rich and oxygen-poor blood traveling in the circulatory system.

fish and larval amphibians
-> two chambers: one atrium and one ventricle
-> atrium receives blood from the body
-> ventricle pumps blood to the gills and then on to the rest of the body

most amphibians
-> three chambers: two atria and one ventricle
-> the left-atrium receives oxygen-rich blood from the lungs
-> the right-atrium receives oxygen-poor blood from the body
-> both atria empty into the ventricle (mixing of blood)
-> the ventricle directs most of the oxygen-poor blood to the lungs and the oxygen-rich blood to the rest of the body

Most reptiles have a three-chambered heart, but most have a partial partition in their ventricle. There is less mixing of oxygen-rich and oxygen-poor blood than there is in amphibians.

birds and mammals
-> four chambers: two atria and two ventricles (double pump)
-> one pump moves blood through the lung loop
-> one pump moves blood through the body loop
-> the two loops are completely separate
-> no mixing of oxygen-rich and oxygen-poor blood

Excretion

Excretory systems eliminate nitrogenous wastes (formed from the breakdown of proteins) from the body.

nonvertebrates and fishes -> gills and gill slits

most vertebrates -> kidneys
-> excretory organs composed of small filtering tubes that remove wastes from the blood

Nitrogenous Wastes

ammonia - highly toxic substance that must be quickly eliminated from the body or changed into a less poisonous form

aquatic amphibians and fishes -> excrete ammonia from the gills into the surrounding water through simple diffusion

land amphibians and mammals -> ammonia is changed to urea before being excreted

reptiles and birds -> ammonia is changed to uric acid

Vertebrate kidneys help maintain homeostasis by regulating the amounts of water, salt, and other substances dissolved in body fluids.

Response

Nonvertebrate chordates have a relatively simple nervous system with a mass of nerve cells that form a brain. Vertebrates have a more complex brain with distinct regions, each with a different function.

Vertebrates display a high degree of cephalization.

The vertebrate brain is divided into several parts: cerebrum, cerebellum, medulla oblongata, optic lobes and olfactory bulbs.

fishes ----------> mammals

size and complexity of cerebrum and cerebellum increase

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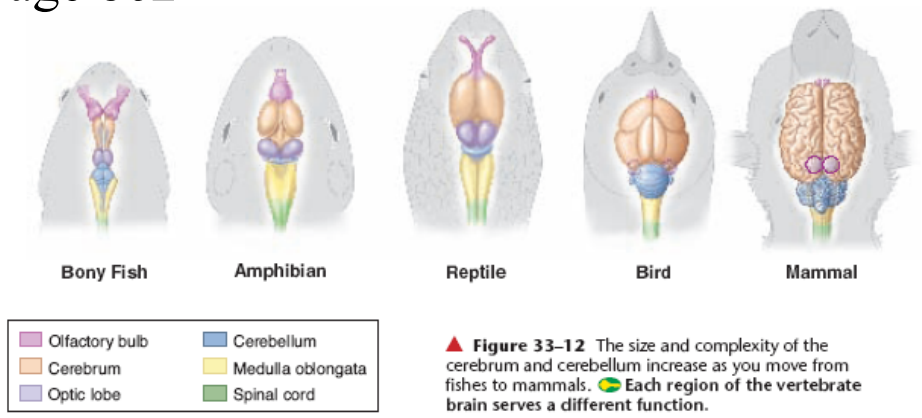

▲ **Figure 33–12** The size and complexity of the cerebrum and cerebellum increase as you move from fishes to mammals. **Each region of the vertebrate brain serves a different function.**

cerebrum - thinking region
- receives, interprets and responds to sensory information
- learning, memory, conscious thought

cerebellum - coordinates movement and controls balance

medulla oblongata - controls the functions of many internal organs

Reproduction

Almost all chordates reproduce sexually.

There is a general trend from external to internal reproduction.

After fertilization, the development of chordates can be oviparous, ovoviviparous or viviparous

oviparous - eggs develop outside the mother's body
- fishes, amphibians and birds

ovoviviparous - eggs develop within the mother's body and embryos receive nutrients from the yolk in the eggs
- sharks

viviparous - embryos obtain nutrients directly from the mother's body

Frog Dissection

Read Pages 782 - 787

Froguts

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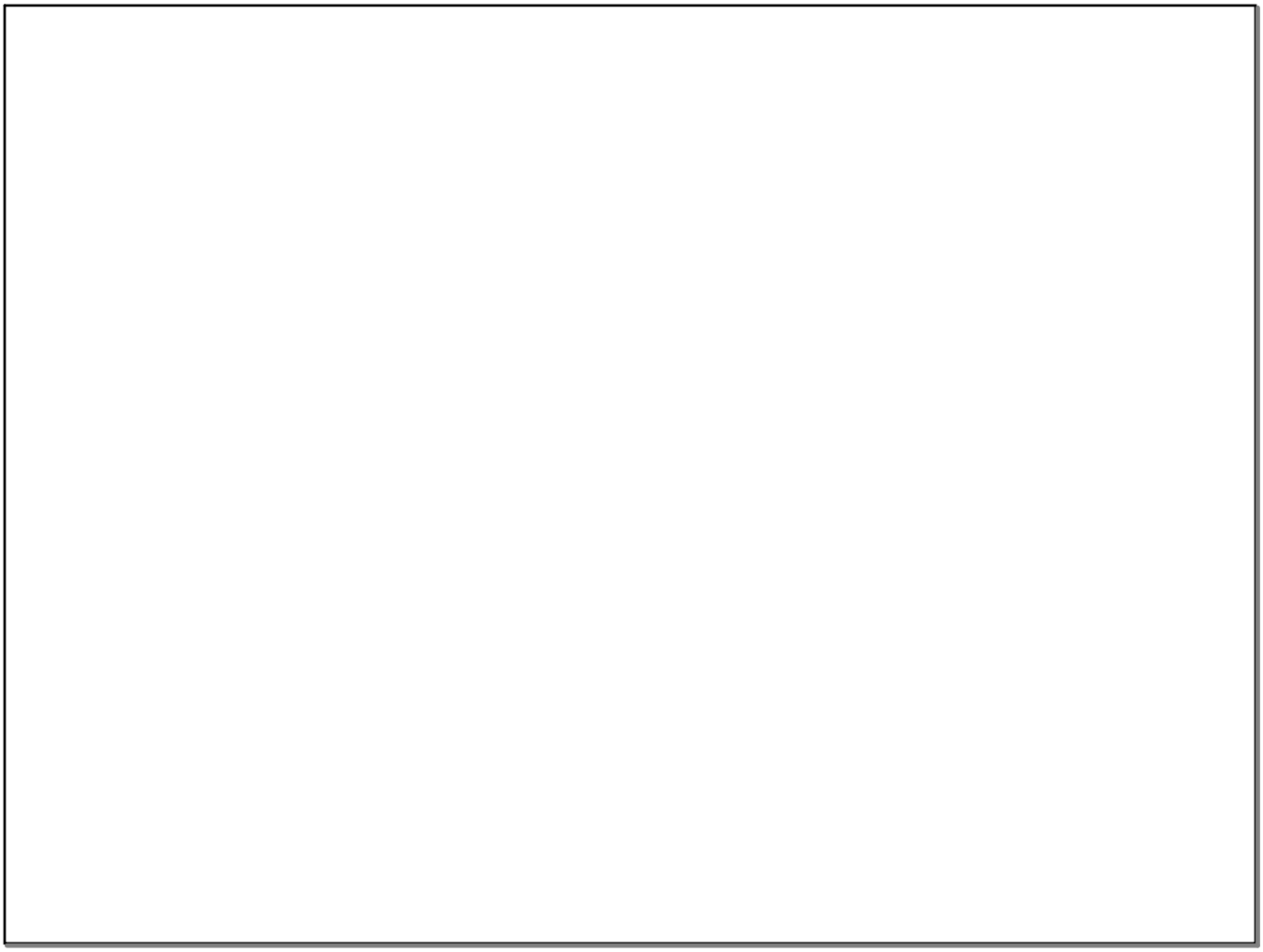

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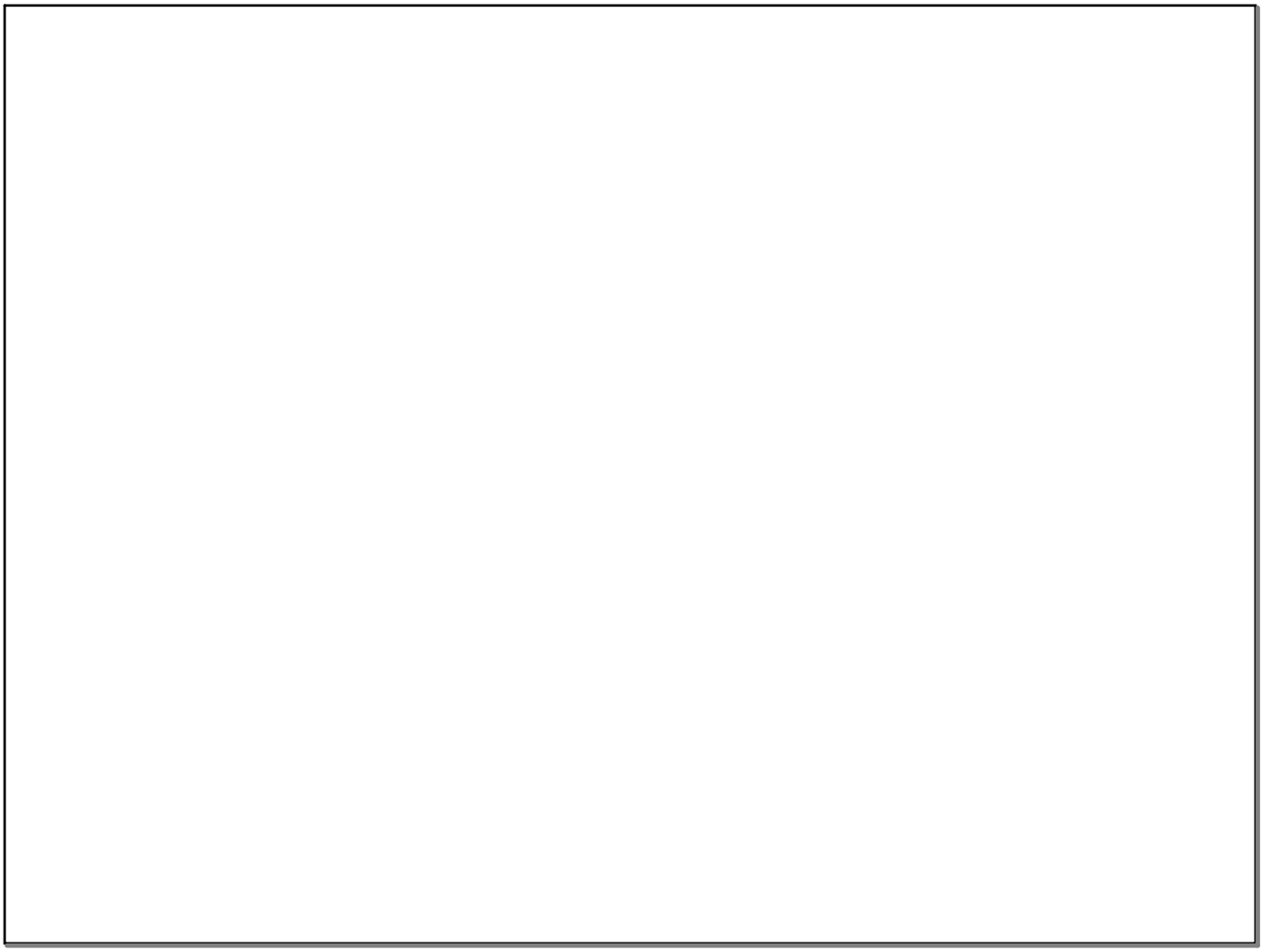

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http://dictionary.reference.com/browse/linnaeus

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