



ZOOLOGI VERTEBRATA Mamalia

KBO 612206 / 3 (2-1)

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Phylum Chordata

L. chorda: tali
G. oura: ekor
G. kephal : kepala

Subphylum Urocordata : tunikata

Subphylum Cephalochordata : lanselet

L. vertebratus : tulang belakang
G. a: tanpa
G. gnathos: rahang
G. stoma: mulut
G. chondros: kartilago
G. ichthys: ikan
G. actis: sinar, pari
G. pteryx: sayap/sirip
G. sarco: daging

Subphylum Vertebrata

Superclass Agnatha

Superclass Gnathostomata

Class Chondrichthyes

Class Actinopterygii

Class Osteichthyes

Class Sarcopterygii

Class Amphibia

G. amphi: dua/double
G. bios: hidup
L. repere: merapa
L. avis: burung
L. mamma: payudara

Class Reptilia

Class Aves

Class Mamalia

Traditional Linnean Classification of Living Members of Phylum Chordata

Phylum Chordata

Subphylum Urochordata (u'ro-kor-da'ta) (Gr. *oura*, tail, + L. *chorda*, cord, + *ata*, characterized by) (**Tunicata**): **tunicates**. Notochord and nerve cord in free-swimming larva only; ascidian adults sessile, encased in tunic. About 1600 species.

Subphylum Cephalochordata (sef'a-lo-kor-da'ta) (Gr. *kephalē*, head, + L. *chorda*, cord): **lancelets (amphioxus)**. Notochord, nerve cord, and postanal tail persist throughout life; fishlike in form. 29 species.

Subphylum Vertebrata (ver'te-bra'ta) (L. *vertebratus*, backbone) (**Craniata**): **vertebrates**. Bony or cartilaginous cranium surrounding tripartite brain; well-developed head with paired sense organs; usually with vertebrae; heart present, with multiple chambers, muscularized digestive tract, paired kidneys.

Superclass Agnatha (ag'na-tha) (Gr. *a*, without, + *gnathos*, jaw): **hagfishes, lampreys**. Without true jaws or paired appendages. A paraphyletic group.

Class Myxini (mik-sin'y) (Gr. *myxa*, slime): **hagfishes**. Mouth with four pairs of tentacles; buccal funnel absent; 1 to 16 pairs of external gill openings; vertebrae absent; slime glands present. About 70 species.

Class Petromyzontida (pet'trō-mī-zon'ti-dā) (Gr. *petros*, stone, + *myzon*, sucking): **lampreys**. Mouth surrounded by keratinized teeth but no barbels, buccal funnel present; seven pairs of external gill openings; vertebrae present only as neural arches. 38 species.

Superclass Gnathostomata (na'tho-sto'ma-ta) (Gr. *gnathos*, jaw, + *stoma*, mouth): **jawed fishes, tetrapods**. With jaws and (usually) paired appendages.

Class Chondrichthyes (kon-drik'thee-eez) (Gr. *chondros*, cartilage, + *ichthys*, fish): **sharks, skates, rays, chimaeras**. Cartilaginous skeleton; intestine with spiral valve; claspers present in males; no swim bladder. About 970 species.

Class Actinopterygii (ak'ti-nop-te-rij'ee-i) (Gr. *aktis*, ray, + *pteryx*, fin, wing): **ray-finned fishes**. Skeleton ossified; single gill opening covered by operculum; paired fins supported primarily by dermal rays; appendage musculature within body; swim bladder mainly a hydrostatic organ, if present; atrium and ventricle not divided. About 27,000 species.

Class Sarcopterygii (sar-cop-te-rij'ee-i) (Gr. *sarkos*, flesh, + *pteryx*, fin, wing): **lobe-finned fishes**. Skeleton ossified, single gill opening covered by operculum; paired fins with sturdy internal skeleton and musculature within appendage; diphyccercal tail; intestine with spiral valve; usually with lunglike swim bladder; atrium and ventricle at least partly divided. 8 species. Paraphyletic unless tetrapods are included.

Class Amphibia (am-fib'e-a) (Gr. *amphi*, both or double, + *bios*, life): **amphibians**. Ectothermic tetrapods; respiration by lungs, gills, or skin; development through larval stage; skin moist, containing mucous glands, and lacking scales. About 5500 species.

Class Reptilia (rep-til'e-a) (L. *repere*, to creep): **reptiles**. Ectothermic tetrapods possessing lungs; embryo develops within shelled egg; no larval stage; skin dry, lacking mucous glands, and covered by epidermal scales. A paraphyletic group unless birds are included. About 8100 species.

Class Aves (ay'veez) (L. pl. of *avis*, bird): **birds**. Endothermic vertebrates with front limbs modified for flight; body covered with feathers; scales on feet. About 9700 species.

Class Mammalia (ma-may'lee-a) (L. *mamma*, breast): **mammals**. Endothermic vertebrates possessing mammary glands; body more or less covered with hair; brain large, with neocortex; three middle ear bones. About 4800 species.

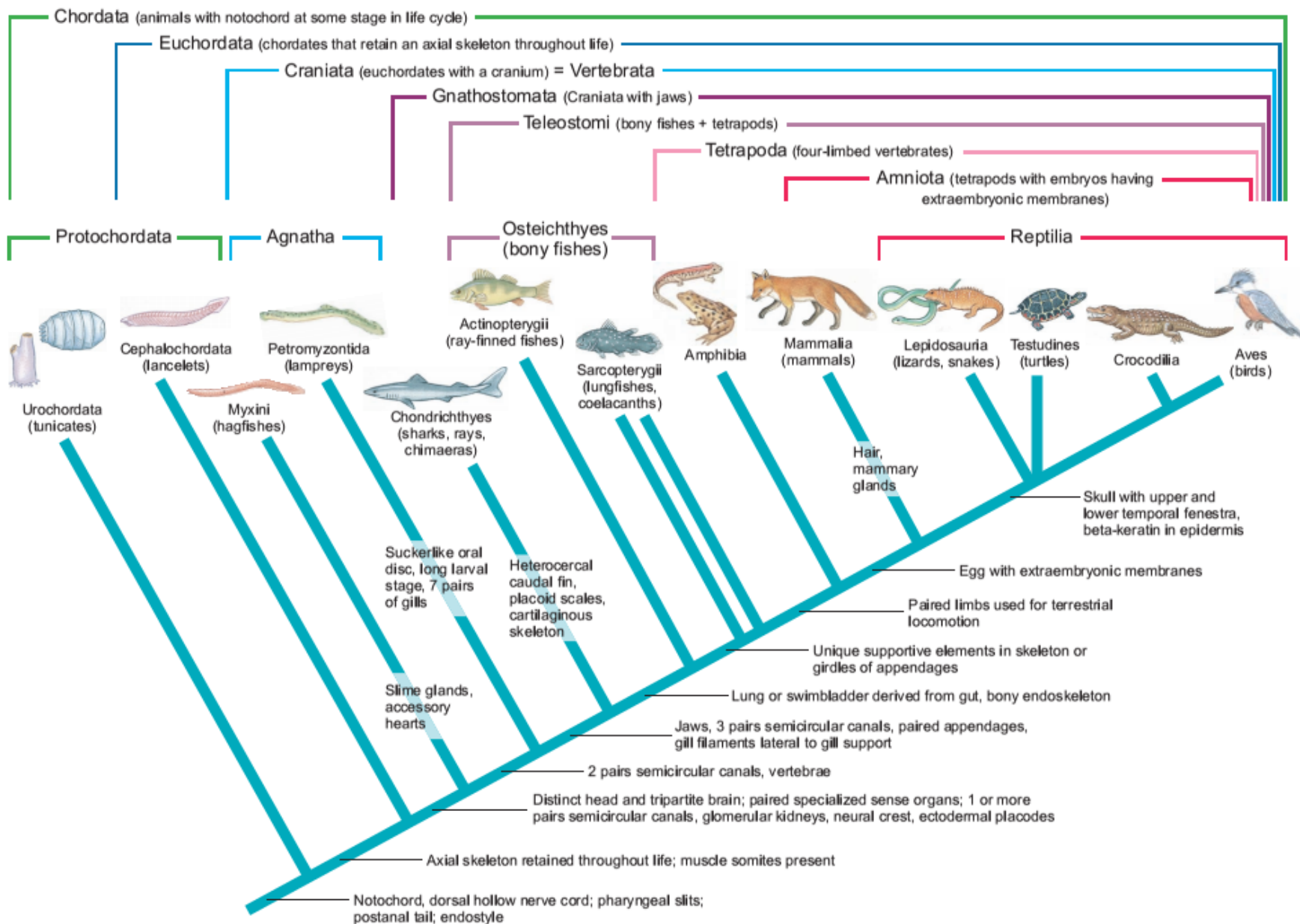
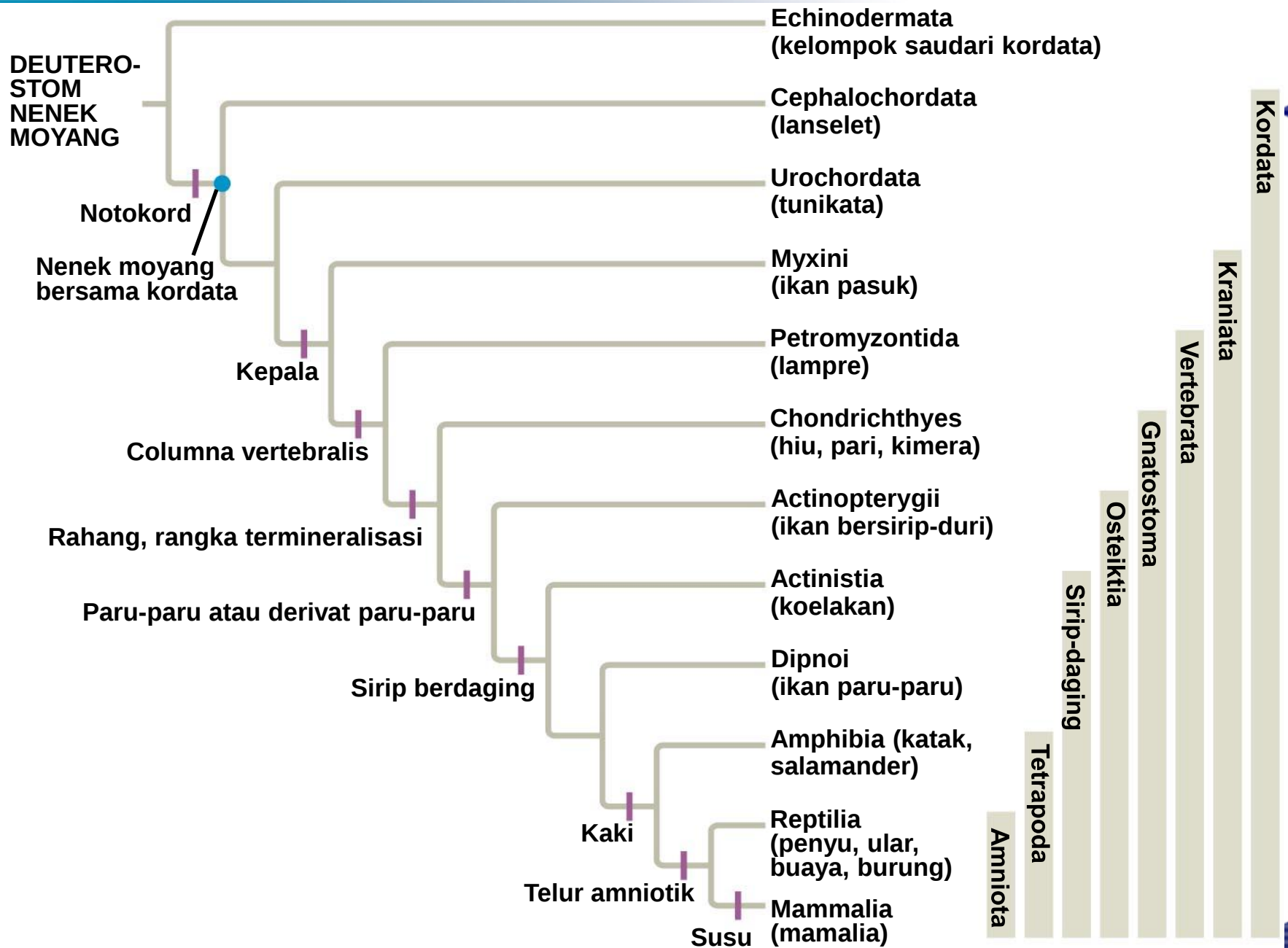


Figure 23.3
 Cladogram of living members of phylum Chordata showing probable relationships of monophyletic groups composing the phylum. Each branch in the cladogram represents a monophyletic group. Some derived character states that identify the branchings are shown at right of the branch points. Nesting brackets across the top of the cladogram identify monophyletic groupings within the phylum. The term Craniata, although commonly equated with Vertebrata, is preferred by many authorities because it recognizes that some jawless vertebrates have a cranium but no vertebrae. The lower set of brackets identify the traditional groupings Protochordata, Agnatha, Osteichthyes, and Reptilia. These paraphyletic groups are not recognized in cladistic treatments, but are shown because of widespread use.



Classification of Living Mammalian Orders¹

Class Mammalia

Subclass Prototheria (pro'to-thir'ee-a) (Gr. *prōtos*, first, + *thēr*, wild animal).

Infraclass Ornithodelphia (or'ni-tho-del'fee-a) (Gr. *ornis*, bird, + *delphys*, womb). Monotreme mammals.

Order Monotremata (mon'o-tre'ma-tah) (Gr. *monos*, single, + *trēma*, hole): **egg-laying (oviparous) mammals: duck-billed platypus, echidnas.** Three

species in this order are from Australia, Tasmania, and New Guinea. The most noted member of the order is the duck-billed platypus, *Ornithorhynchus anatinus*. Spiny anteaters, or echidnas, *Tachyglossus*, have a long, narrow snout adapted for feeding on ants, their chief food.

Subclass Theria (thir'ee-a) (Gr. *thēr*, wild animal).

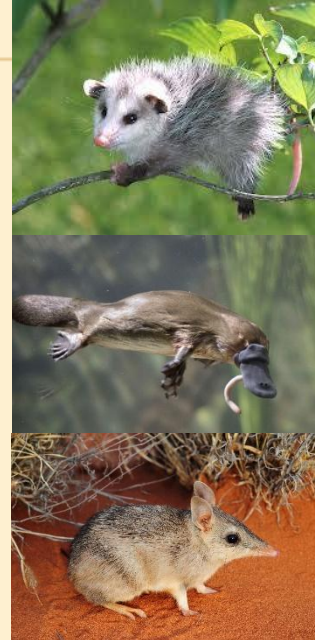
Infraclass Metatheria (met'a-thir'ee-a) (Gr. *meta*, after, + *thēr*, wild animal). Marsupial mammals.

Order Didelphimorphia (dy'del-fi-mor'fee-a) (Gr. *di*, two, + *delphi*, uterus, + *morph*, form): **American opossums.** These mammals, like other marsupials, are characterized by an abdominal pouch, or marsupium, in which they rear their young. Most species are found in Central and South America, but one species, the Virginia opossum, *Didelphis virginiana*, is widespread in North America; 66 species.

Order Paucituberculata (pos'see-tu-ber-cu-la'ta) (L. *pauci*, few, + *tuberculum*, knob): **shrew opossums.** Tiny, shrew-sized marsupials found in western South America; seven species.

Order Microbiotheria (my'cro-by-o-ther'ee-a) (Gr. *micro*, small, + *bio*, life, + *thēr*, wild animal):

Monito del Monte. A South American mouse-sized marsupial that may be more closely related to Australian marsupials; one species.



Order Dasyuromorphia (das-ee-yur'o-mor'fee-a) (Gr. *dasy*, hairy, + *uro*, tail, + *morph*, form): **Australian carnivorous mammals.** In addition to a number of larger carnivores, this order includes a number of marsupial "mice," all of which are carnivorous. Confined to Australia, Tasmania, and New Guinea; 64 species.

Order Peramelemorphia (per'a-mel-e-mor'fee-a) (Gr. *per*, pouch, + *mel*, badger, + *morph*, form): **bandicoots.** Like placentals, members of this group have a chorioallantoic placenta and a high rate of reproduction for marsupials. Confined to Australia, Tasmania, and New Guinea; 22 species.

Order Notoryctemorphia (no'to-rikt'te-mor'fee-a) (Gr. *not*, back, + *oryct*, digger, + *morph*, form): **marsupial moles.** Bizarre, semifossorial marsupials present in Australia; two species.

Order Diprotodontia (dy'pro-to-don'tee-a) (Gr. *di*, two, + *pro*, front, + *odont*, tooth): **koalas, wombats, possums, wallabies, kangaroos.** Diverse marsupial group containing some of the largest and most familiar

Infraclass Eutheria (yu-thir'ee-a) (Gr. *eu*, true, + *thēr*, wild animal). Placental mammals.

Order Insectivora (in-sec-tiv'o-ra) (L. *insectum*, an insect, + *vorare*, to devour): **insect-eating mammals: shrews, hedgehogs, tenrecs, moles.** Small, sharp-snouted animals that spend a great part of their lives underground. Distributed throughout the world except for Australia and New Zealand. Shrews are among the smallest mammals known; 440 species.

Order Macroscelidea (mak-ro-sa-lid'ee-a) (Gr. *makros*, large, + *skelos*, leg): **elephant shrews.** Secretive mammals with long legs, a snoutlike nose adapted for foraging for insects, large eyes. Widespread in Africa; 15 species.

Order Dermoptera (der-mop'ter-a) (Gr. *derma*, skin, + *pteron*, wing): **flying lemurs.** These are related to true bats and consist of a single genus *Galeopithecus*. They are not lemurs (which are primates) and cannot fly but glide like flying squirrels. They occur in the Malay peninsula in the East Indies; two species.

Order Chiroptera (ky-rop'ter-a) (Gr. *cheir*, hand, + *pteron*, wing): **bats.** Wings of bats, the only true flying mammals, are modified forelimbs in which the second to fifth digits are elongated to support a thin integumental membrane for flying. The first digit (thumb) is short with a claw. Common North American forms are little brown bats, *Myotis*, free-tailed bats, *Tadarida*, and big brown bats, *Eptesicus*. In Old World tropics fruit bats, or "flying foxes," *Pteropus*, are largest of all bats, with a wingspread of 1.2 to 1.5 m; they live chiefly on fruits; 977 species.

Order Scandentia (skan-dent'e-a) (L. *scandentis*, climbing): **tree shrews.** Small, squirrel-like mammals of the tropical rain forests of southern and southeastern Asia. Despite their name, many are not especially well-adapted for life in trees, and some are almost completely terrestrial; 16 species.

Order Primates (pry-may'teez) (L. *prima*, first): **prosimians, monkeys, apes, humans.** First in the animal kingdom in brain development, with especially large cerebral cortex. Most species are arboreal, apparently derived from tree-dwelling insectivores. It is believed that their tree-dwelling habits of agility in capturing food or avoiding enemies were largely responsible for their advances in brain structure. As a group they are generalized with five digits (usually provided with flat nails) on both forelimbs and hindlimbs. All except humans have their bodies covered with hair. Forelimbs are often adapted for grasping, as are the hindlimbs sometimes. The group is singularly lacking in claws, scales, horns, and hoofs. There are two suborders; 279 species.

Suborder Strepsirhini (strep'suh-ry-nee)

(Gr. *strepsō*, to turn, twist, + *rhinos*, nose): **lemurs, aye-aye, lorises, pottos, bush babies.** Seven families of arboreal primates, formerly called prosimians,



Suborder Haplorhini (hap'lo-ry-nee) (Gr. *haploos*, single, simple, + *rhinos*, nose): **tarsiers, marmosets, New and Old World monkeys, gibbons, gorilla, chimpanzees, orangutan, humans**. Six families, all except tarsiers are in the clade Anthropoidea. Haplorhine primates have dry, hairy noses, ringed nostrils and differences in skull morphology that distinguish them from strepsirhine primates. Family **Tarsiidae** contains crepuscular and nocturnal tarsiers (Figure 28.31), with large, forward-facing eyes and reduced snout (five species). New World Monkeys, sometimes called platyrrhine monkeys because the nostrils are widely separated, are contained in two families: **Callitrichidae** (marmosets and tamarins; 35 species) and **Cebidae** (capuchin-like monkeys; 65 species). Callitrichids, which include the colorful lion tamarins, have prehensile hands and quadrupedal locomotion. Cebid monkeys are much larger than any callitrichid. They include capuchin monkeys, *Cebus*, spider monkeys, *Ateles*, and howler monkeys, *Alouatta*. Some cebids (including spider and howler monkeys) have prehensile tails, used like an additional hand for grasping and swinging.



Order Pholidota (fol'i-do'ta) (Gr. *pholis*, horny scale): **pangolins**. An odd group of mammals whose bodies are covered with overlapping horny scales formed from fused bundles of hair. Their home is in tropical Asia and Africa; seven species.

Order Lagomorpha (lag'o-mor'fa) (Gr. *lagos*, hare, + *morphe*, form): **rabbits, hares, pikas** (Figure 28.38). With long, constantly growing incisors, like rodents, but unlike rodents, they have an additional pair of peglike incisors growing behind the first pair. All lagomorphs are herbivores with cosmopolitan distribution; 81 species.

Order Rodentia (ro-den'che-a) (L. *rodere*, to gnaw): **gnawing mammals: squirrels, rats, woodchucks**. Most numerous of all mammals both in numbers

Order Carnivora (car-niv'o-ra) (L. *caro*, flesh, + *vorare*, to devour): **flesh-eating mammals: dogs, wolves, cats, bears** (Figure 28.39), **weasels, seals, sea lions** (Figure 28.40), **walruses**. All except the giant panda, have predatory habits, and their teeth are

Order Tubulidentata (tu'byu-li-den-ta'ta) (L. *tubulus*, tube, + *dens*, tooth): **aardvark**. "Aardvark" is Dutch for earth pig, a peculiar animal with a piglike body found in Africa; one species.

Order Proboscidea (pro'ba-sid'e-a) (Gr. *proboskis*, elephant's trunk, from *pro*, before, + *boskein*, to feed): **proboscis mammals: elephants**. Largest of living land animals, with two upper incisors elongated as tusks, and well-developed molar teeth. Asiatic or Indian elephants, *Elephas maximus*, have long been partly domesticated and trained to do heavy tasks. Taming of African elephants, *Loxodonta africana*, is more difficult but was done extensively by ancient Carthaginians and Romans, who employed them in their armies; two species.

Order Hyracoidea (hy'ra-coi'de-a) (Gr. *hyrax*, shrew): **hyraxes** (coney). Coneys are herbivores restricted to Africa and Syria. They have some resemblance to short-eared rabbits but have teeth like rhinoceroses, with hooves on their toes and pads on their feet. They have four toes on the front feet and three toes on the back; seven species.

Order Sirenia (sy-re'ne-a) (Gr. *seiren*, sea nymph): **sea cows and manatees**. Large, clumsy, aquatic mammals with large head, no hindlimbs, and forelimbs modified into flippers. The sea cow (dugong) of tropical coastlines of East Africa, Asia, and Australia and three species of manatees of the Caribbean area and Florida, Amazon River, and West Africa are the only living species. A fifth species, the large Steller's sea cow, was hunted to extinction by humans in the mid-eighteenth century; four species.

Order Perissodactyla (pe-ris'so-dak'ti-la) (Gr. *perissos*, odd, + *dactylos*, toe): **odd-toed hoofed mammals: horses, asses, zebras, tapirs, rhinoceroses**. Odd-toed hoofed mammals have an odd number of toes (one or three), each with a cornified hoof. Both Perissodactyla and Artiodactyla are often referred to as **ungulates** (L. *ungula*, hoof), or hoofed mammals, with teeth adapted for grinding plants. The horse family (Equidae), which also includes asses and zebras, has only one functional toe. Tapirs have a short proboscis formed from the upper lip and nose. The rhinoceros, *Rhinoceros*, includes several species found in Africa and Southeast Asia. All are herbivorous; 17 species.

Order Artiodactyla (ar'te-o-dak'ti-la) (Gr. *artios*, even, + *dactylos*, toe): **even-toed hoofed mammals: swine, camels, deer and their allies, giraffes, hippopotamuses, antelopes, cattle, sheep, goats**. Most of these ungulates have two toes, although the hippopotamus and some others have four (Figure 28.41). Each toe is sheathed in a cornified hoof. Many, such as cattle, deer, and sheep have horns or antlers. Many are ruminants. Most are strictly herbivores, but some species, such as pigs, are omnivorous. The group is divided into nine living families and many extinct ones and includes some of the most valuable domestic animals. Artiodactyla is commonly divided into three suborders: the **Suina** (pigs, peccaries, and hippopotamuses), the **Tylopoda** (camels), and the **Ruminantia** (deer, giraffes, sheep, cattle); 221 species.

Order Cetacea (see-tay'she-a) (L. *cetus*, whale): **whales** (Figure 28.42), **dolphins, porpoises**.



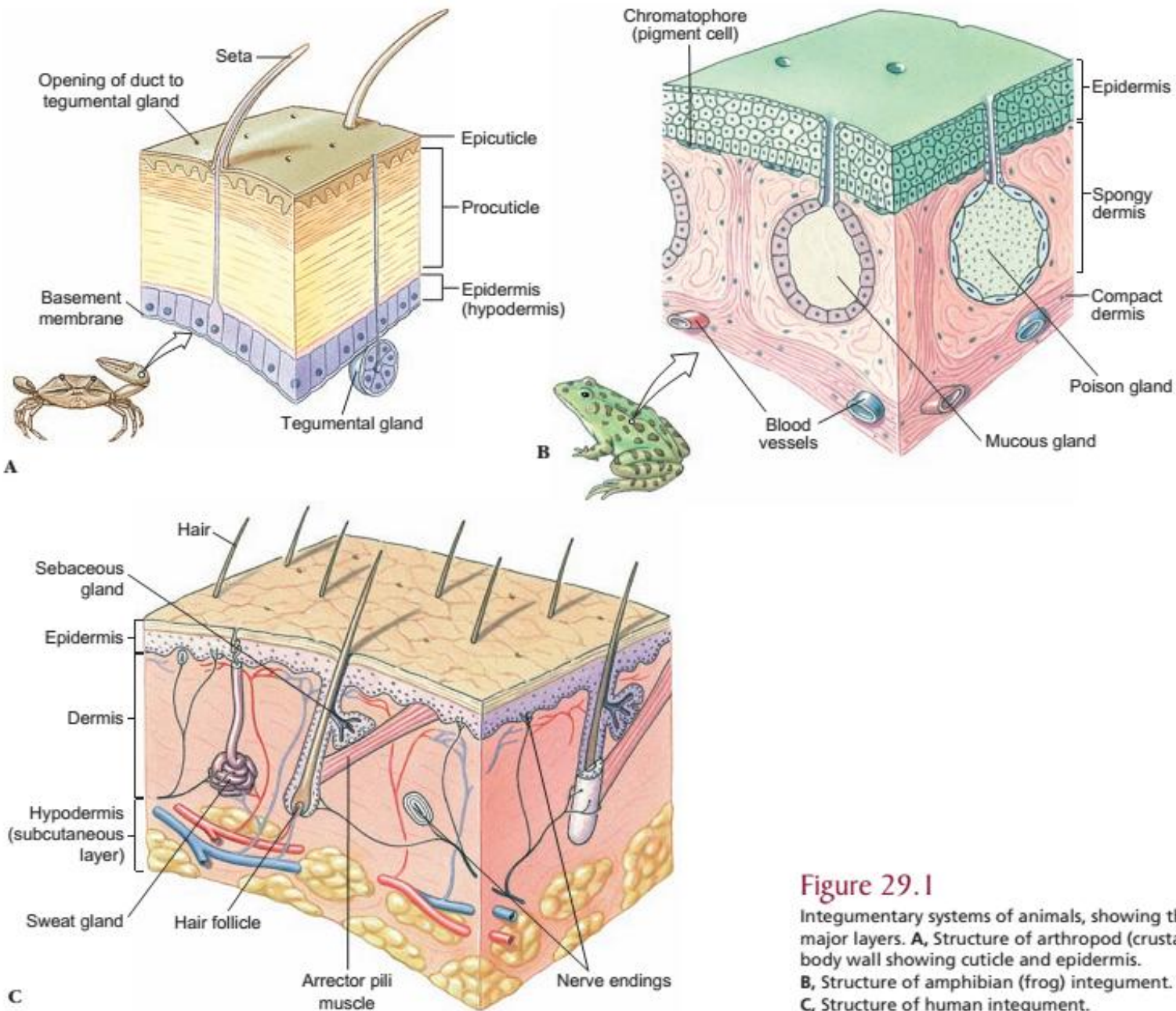


Figure 29.1

Integumentary systems of animals, showing the major layers. **A**, Structure of arthropod (crustacean) body wall showing cuticle and epidermis. **B**, Structure of amphibian (frog) integument. **C**, Structure of human integument.

Figure 28.11

Feeding specializations of major trophic groups of eutherian mammals. Early eutherians were insectivores; all other types are descended from them.

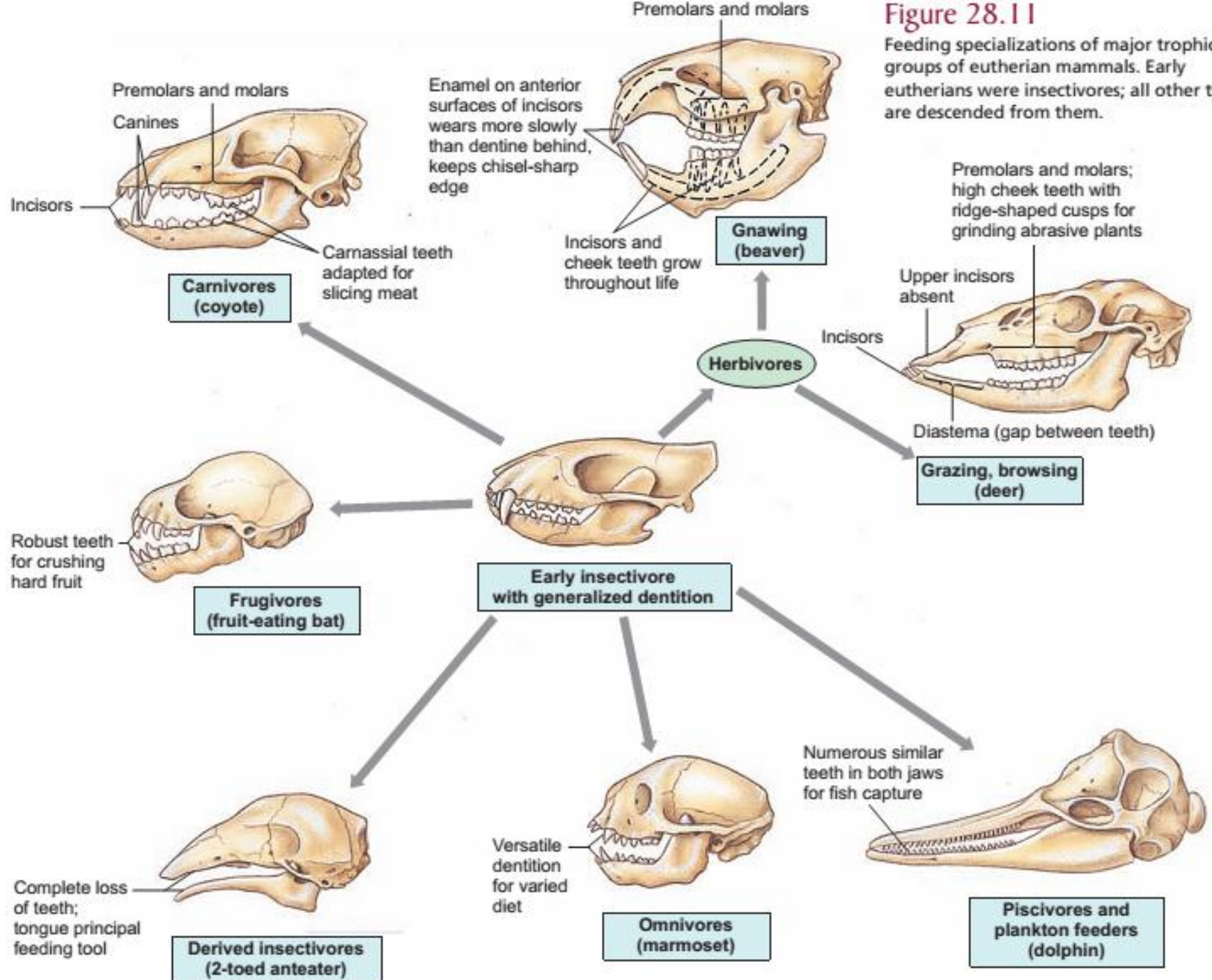
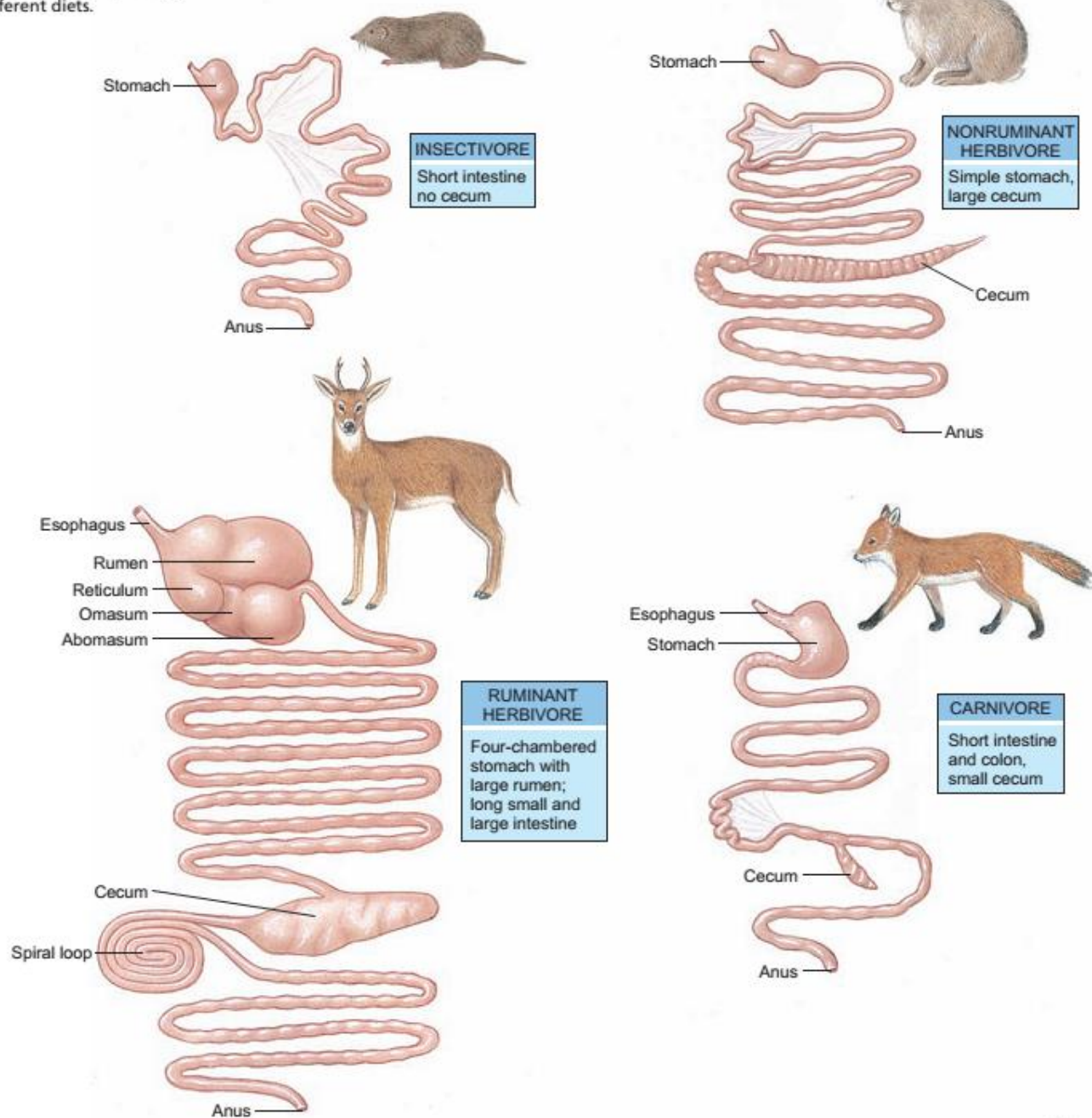


Figure 28.12

Digestive systems of mammals, showing different morphology with different diets.



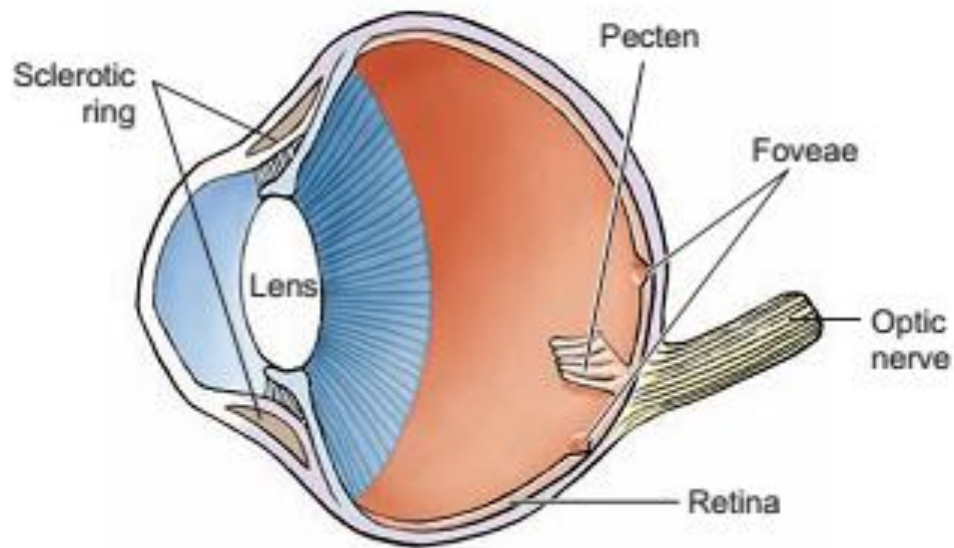
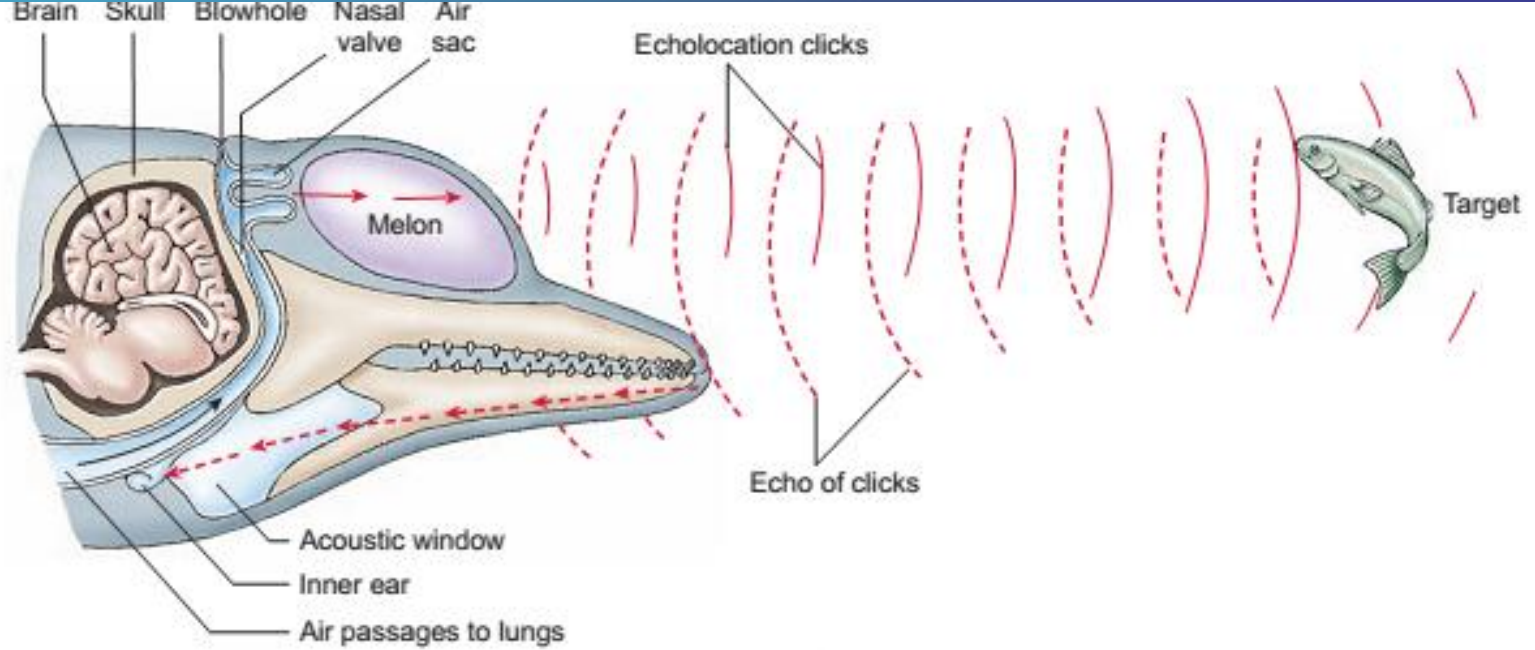


Figure 27.15

A hawk eye has all the structural components of a mammalian eye, plus a peculiar pleated structure, the pecten, believed to provide nourishment to the retina. The extraordinarily keen vision of hawks is attributed to the extreme density of cone cells in the foveae: 1.5 million per fovea compared to 0.2 million for humans.



In dolphins, clicks are produced by moving air through the nasal canal and are focused into beams through the melon. Returning sounds primarily are received through the acoustic window, a posterior part of the mandibular with very thin bone, and channeled through oil in the mandible to the middle and inner ears.

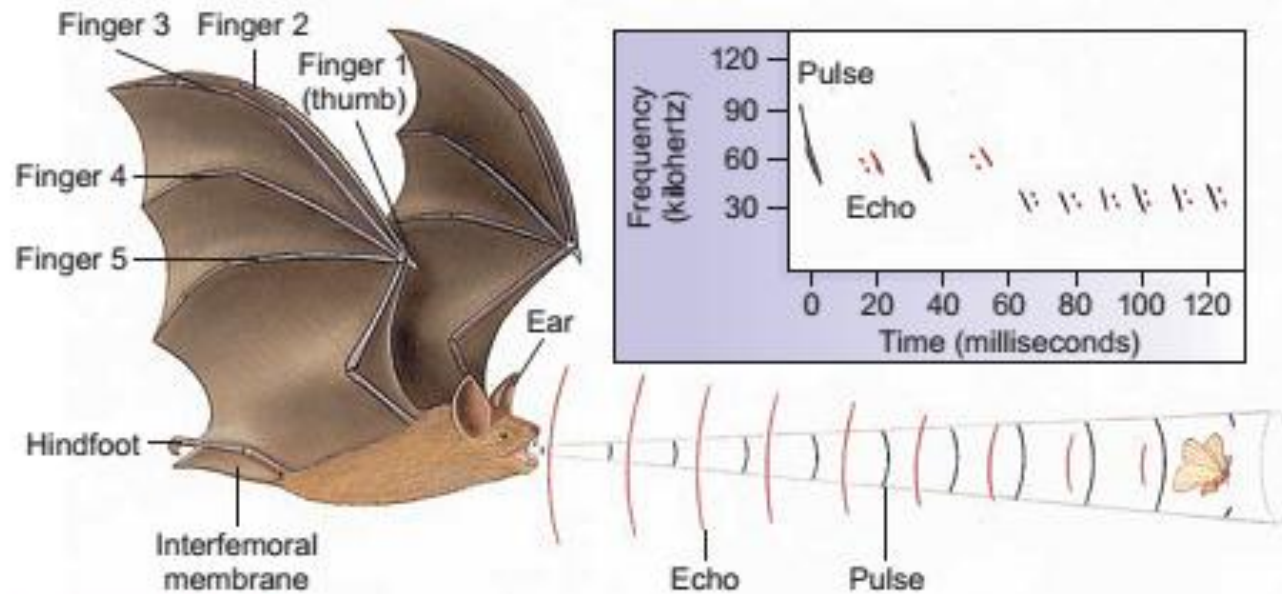
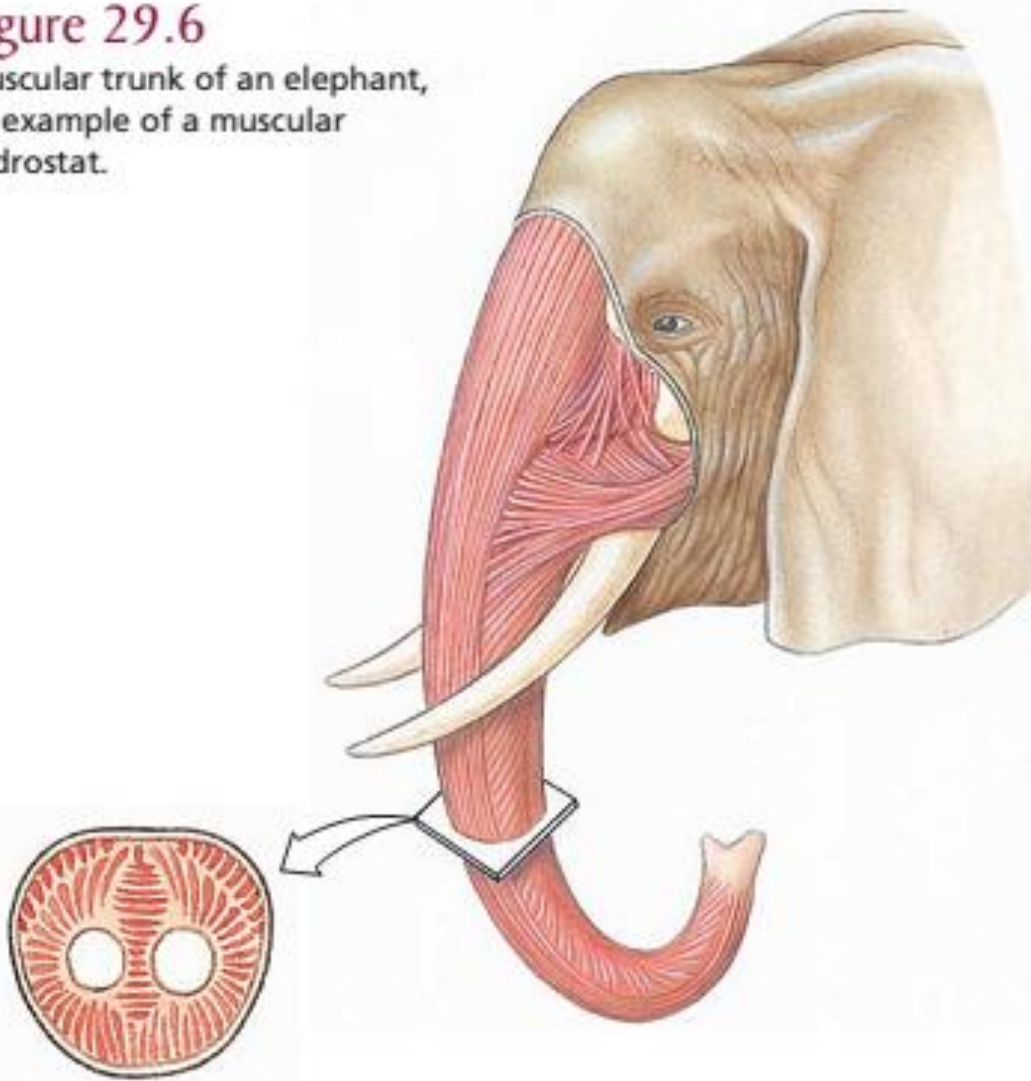


Figure 28.20

Echolocation of an insect by a little brown bat, *Myotis lucifugus*. Frequency modulated pulses are directed in a narrow beam from the bat's mouth. As the bat nears its prey, it emits shorter, lower signals at a faster rate. Order Chiroptera, family Vespertilionidae.

Figure 29.6

Muscular trunk of an elephant,
an example of a muscular
hydrostat.



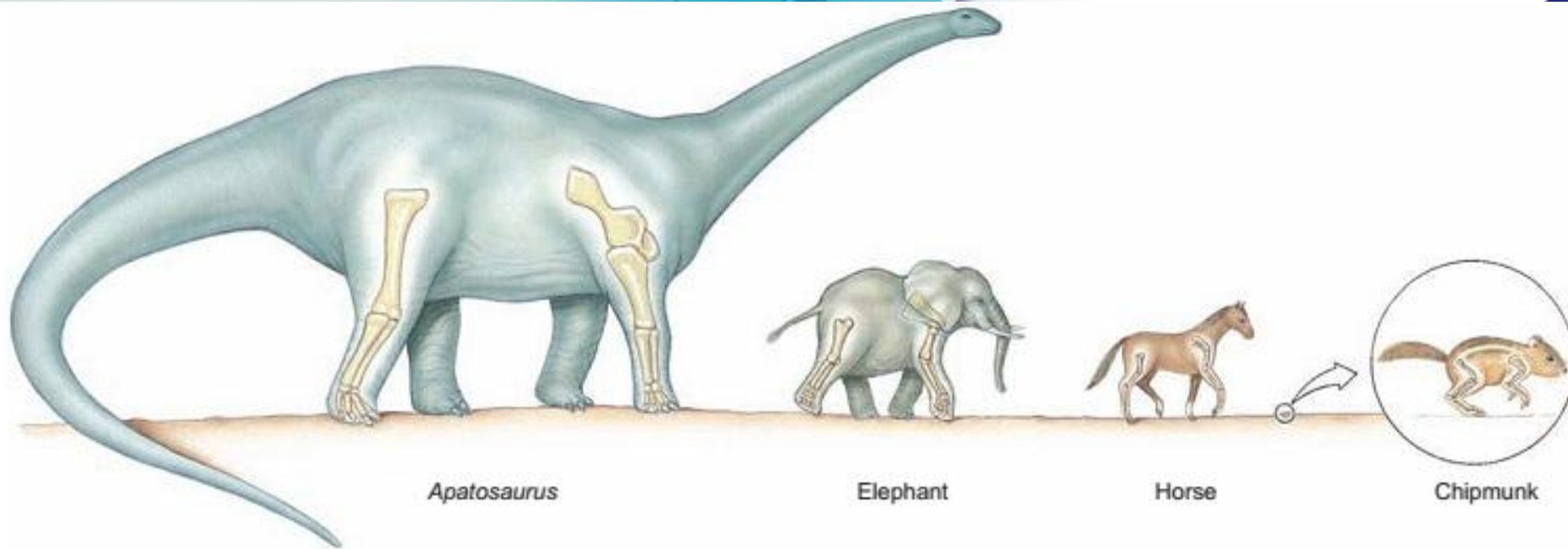


Figure 29.10

Comparison of postures in small and large mammals, showing the effect of scale. Because of its more upright posture, bone stresses in the horse are similar to those in the chipmunk. In mammals larger than horses (above about 300 kg), greatly increased stresses require that bones become exceedingly robust and that the animal lose agility.



Figure 28.21

African lions, *Panthera leo*, mating. Lions breed at any season, although predominantly in spring and summer. During the short period a female is receptive, she may mate repeatedly. Three or four cubs are born after gestation of 100 days. Once the mother introduces the cubs into the pride, they are treated with affection by both adult males and females. Cubs go through an 18- to 24-month apprenticeship learning how to hunt and then are frequently driven from the pride to manage themselves. Order Carnivora, family Felidae.

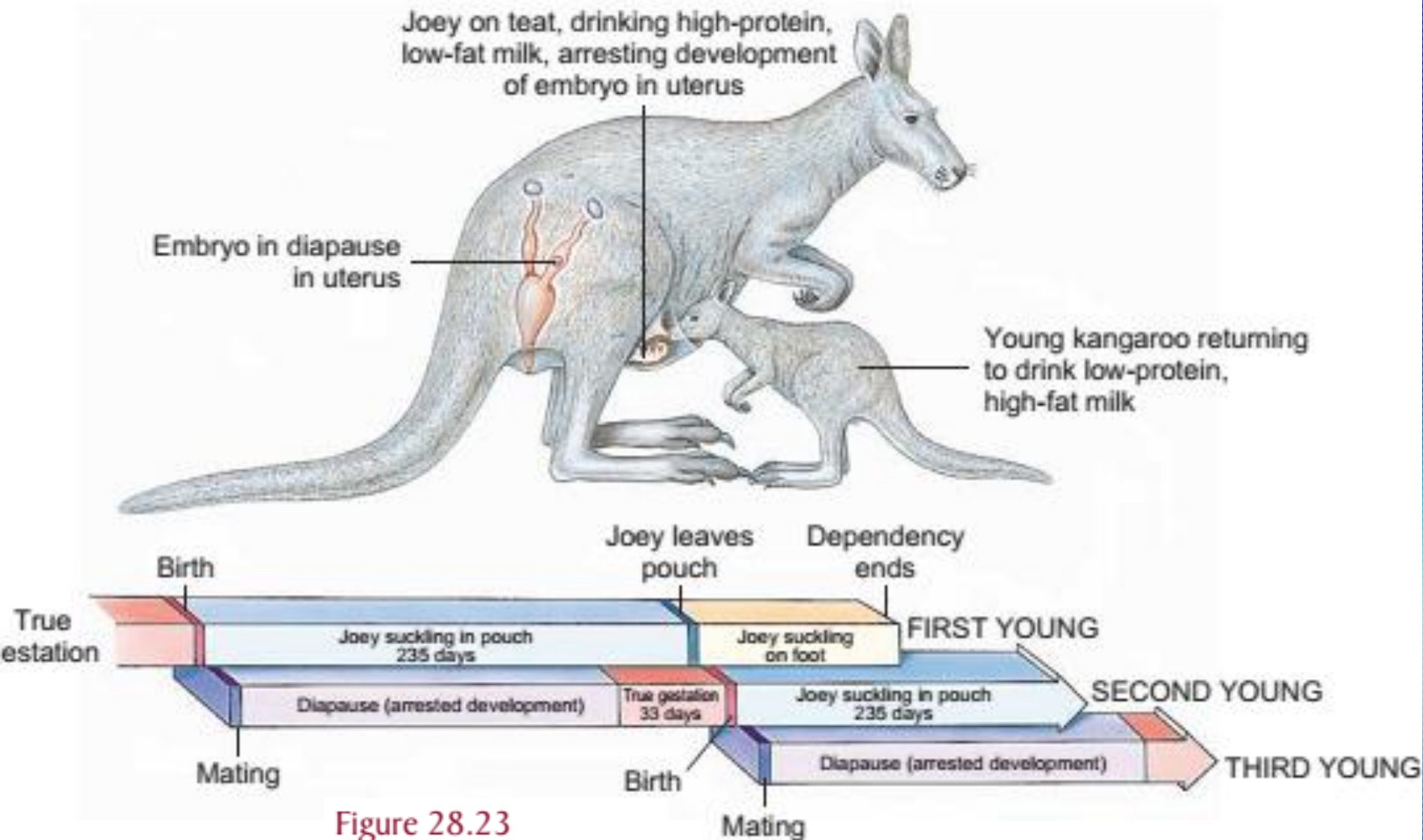


Figure 28.23

Kangaroos have a complicated reproductive pattern in which the mother may have three young in different stages of development dependent on her at once. Order Diprotodontia, family Macropodidae.

Figure 28.24

Southern opossums, *Didelphis marsupialis*, 15 days old, fastened to teats in mother's pouch. When born after a gestation period of only 12 days, they are the size of honey bees. They remain attached to the nipples for 50 to 60 days. Order Didelphimorpha, family Didelphidae.



Struktur Sistem Ekskresi Mamalia

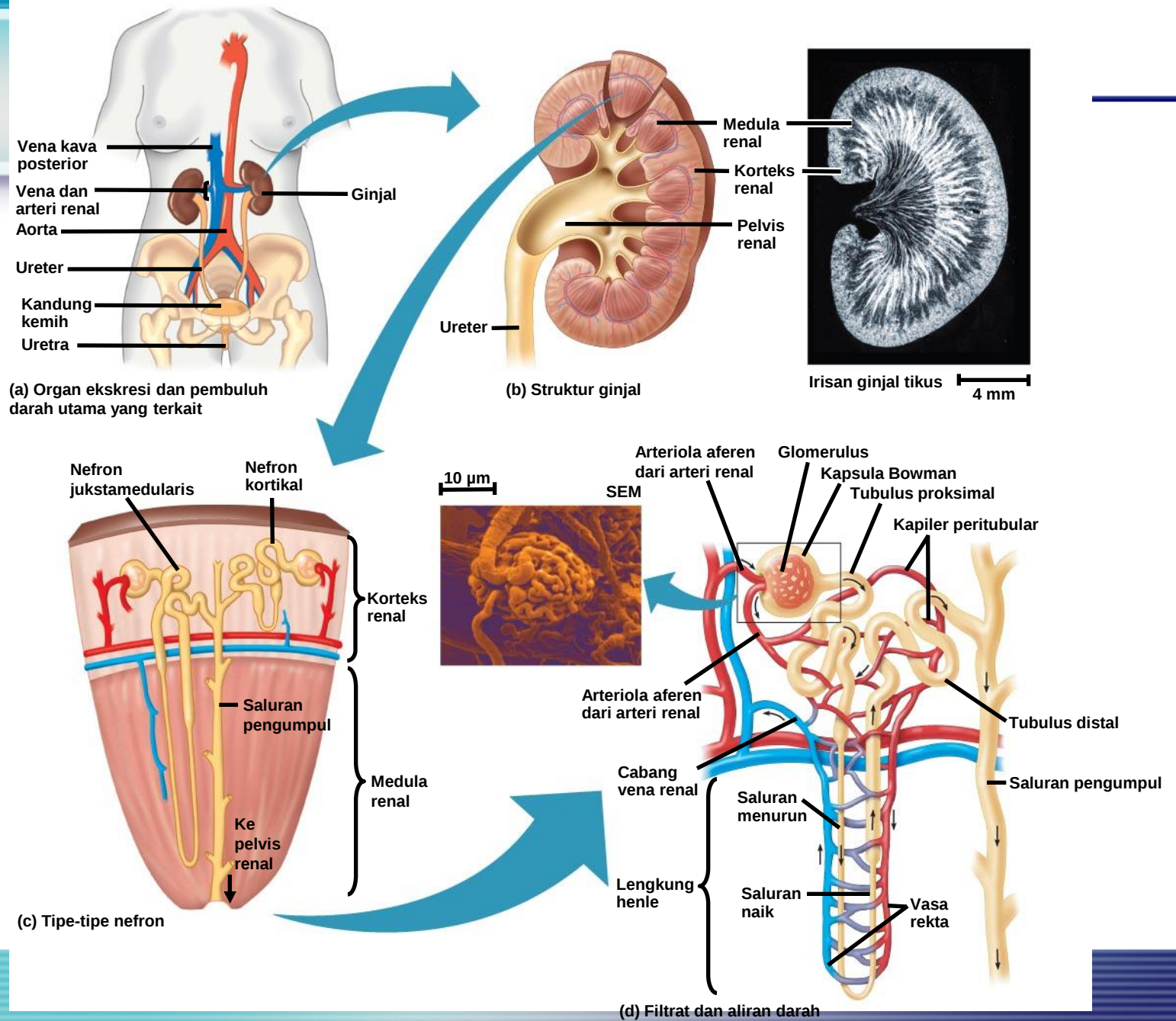


- Sistem ekskresi mamalia berpusat pada sepasang ginjal, yang juga merupakan tempat utama untuk keseimbangan air dan regulasi garam
- Setiap ginjal disuplai oleh darah melalui **arteri renal** (*renal artery*) dan dialirkan melalui **vena renal** (*renal vein*)
- Urin keluar dari setiap ginjal melalui suatu saluran yang disebut **ureter**
- Kedua ureter mengalir ke dalam **kandung kemih** (*urinary bladder*), dan urin dibuang melalui **uretra**

Mamalia



- Nefron jukstamedularis berkontribusi terhadap konservasi air pada hewan darat
- Mamalia yang mendiami lingkungan kering memiliki lengkung Henle yang panjang, sedangkan mamalia yang mendiami perairan tawar memiliki lengkung Henle yang relatif pendek





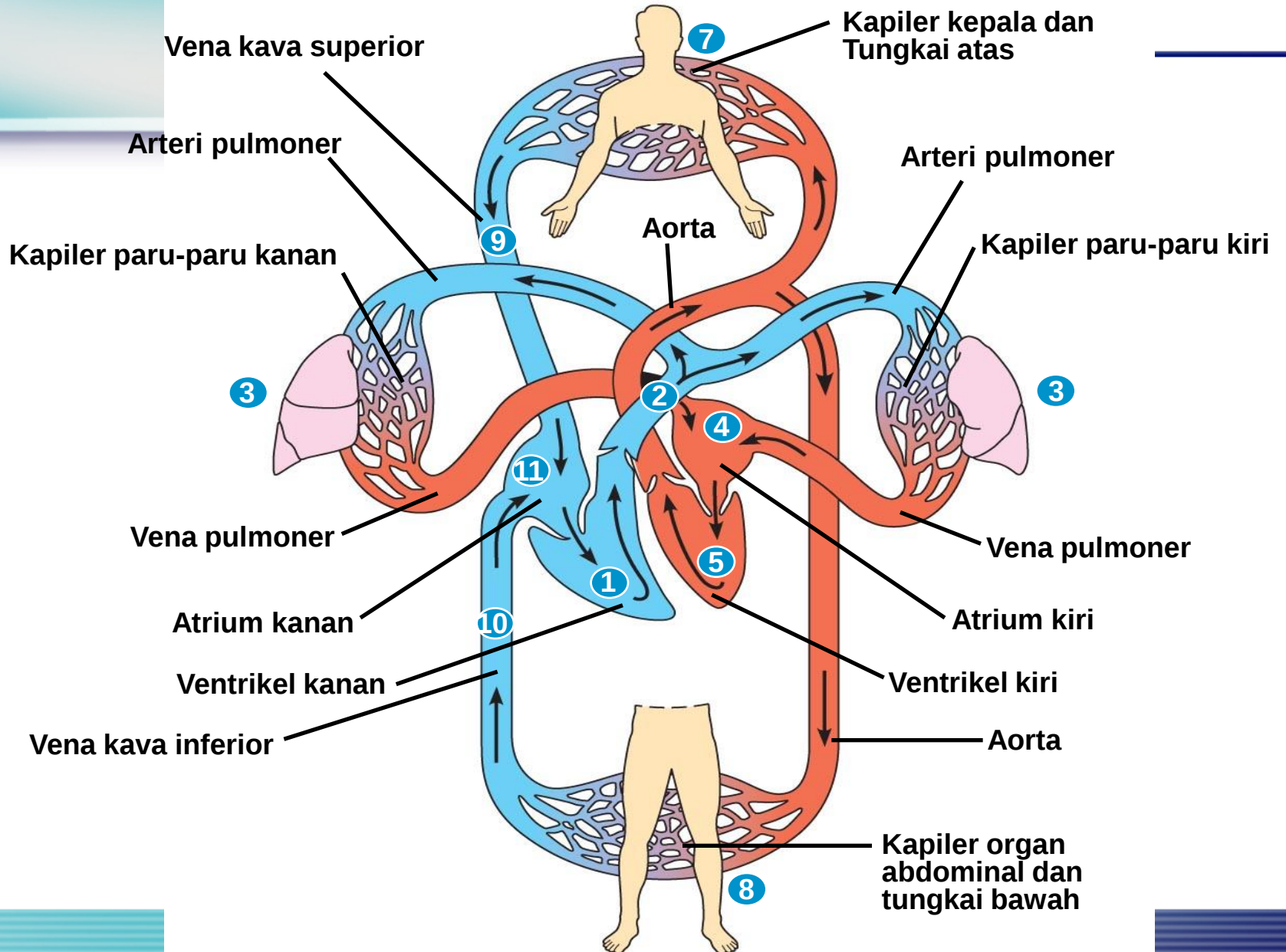
- Ginjal mamalia memiliki **korteks renal** di bagian luar dan **medula renal** di bagian dalam
- **Nefron**, satuan fungsional dari ginjal vertebrata, terdiri atas satu tubulus tunggal yang panjang serta sebuah bola kapiler yang disebut **glomerulus**
- **Kapsula Bowman** mengelilingi dan menerima filtrat dari glomerulus

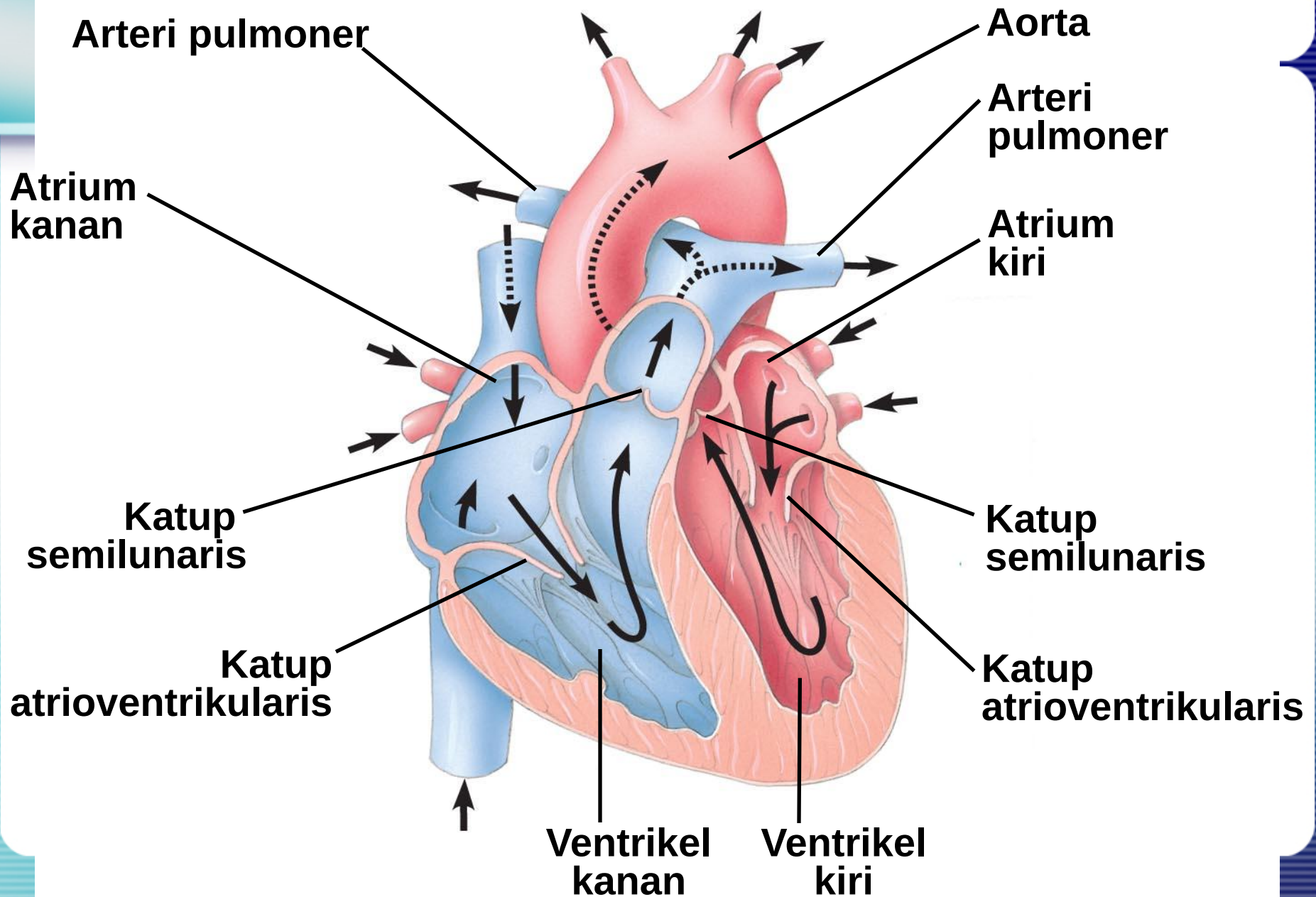


- Mamalia mengontrol volume dan osmolaritas urin
- Ginjal kelelawar vampir amerika selatan dapat menghasilkan urin yang sangat encer atau urin yang sangat pekat
- Hal ini memungkinkan kelelawar dapat mengurangi bobot tubuhnya dengan cepat atau mencerna sejumlah besar protein sambil mengonservasi air



Kelelawar vampir amerika selatan ini mengilustrasikan keserbabisaan dari ginjal mamalia.

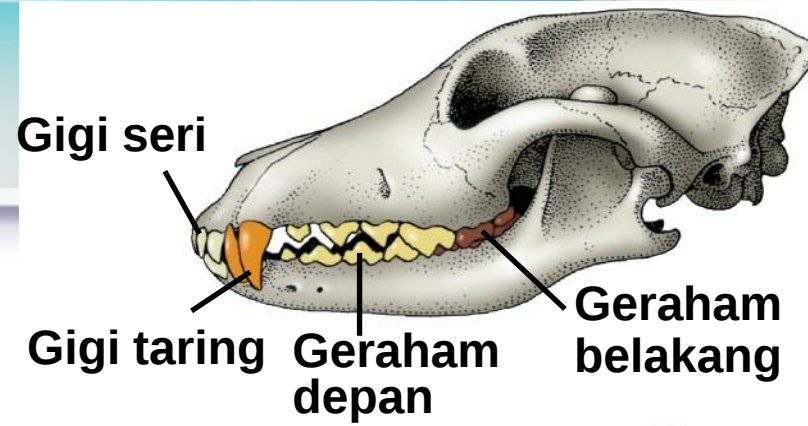




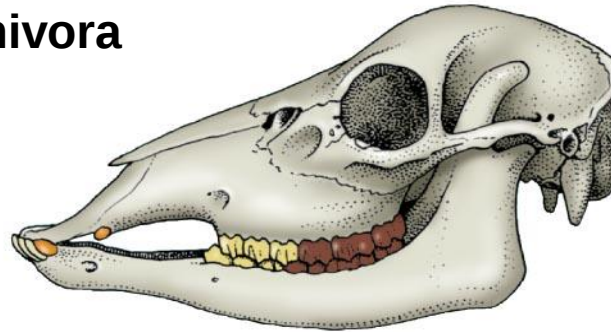
Beberapa Adaptasi Gigi



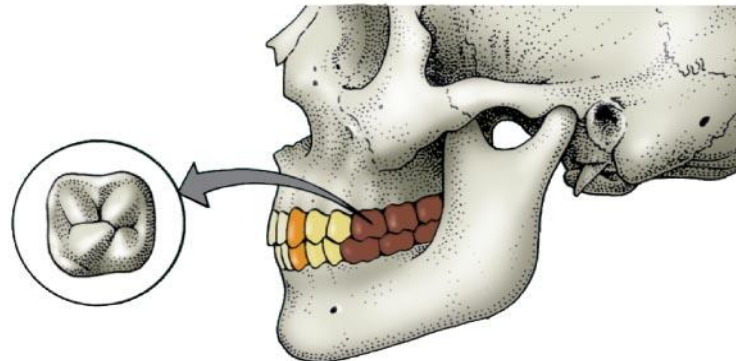
- Dentisi, susunan gigi-gigi hewan, merupakan salah satu contoh variasi struktural yang mencerminkan diet
- Mamalia memiliki dentisi yang bervariasi yang teradaptasi dari diet kebiasaan mereka
- Gigi ular berbisa termodifikasi sebagai taring bisa untuk menyuntikkan bisa (venom)
- Semua ular dapat membuka mulut sangat lebar untuk menelan utuh mangsanya



(a) Karnivora



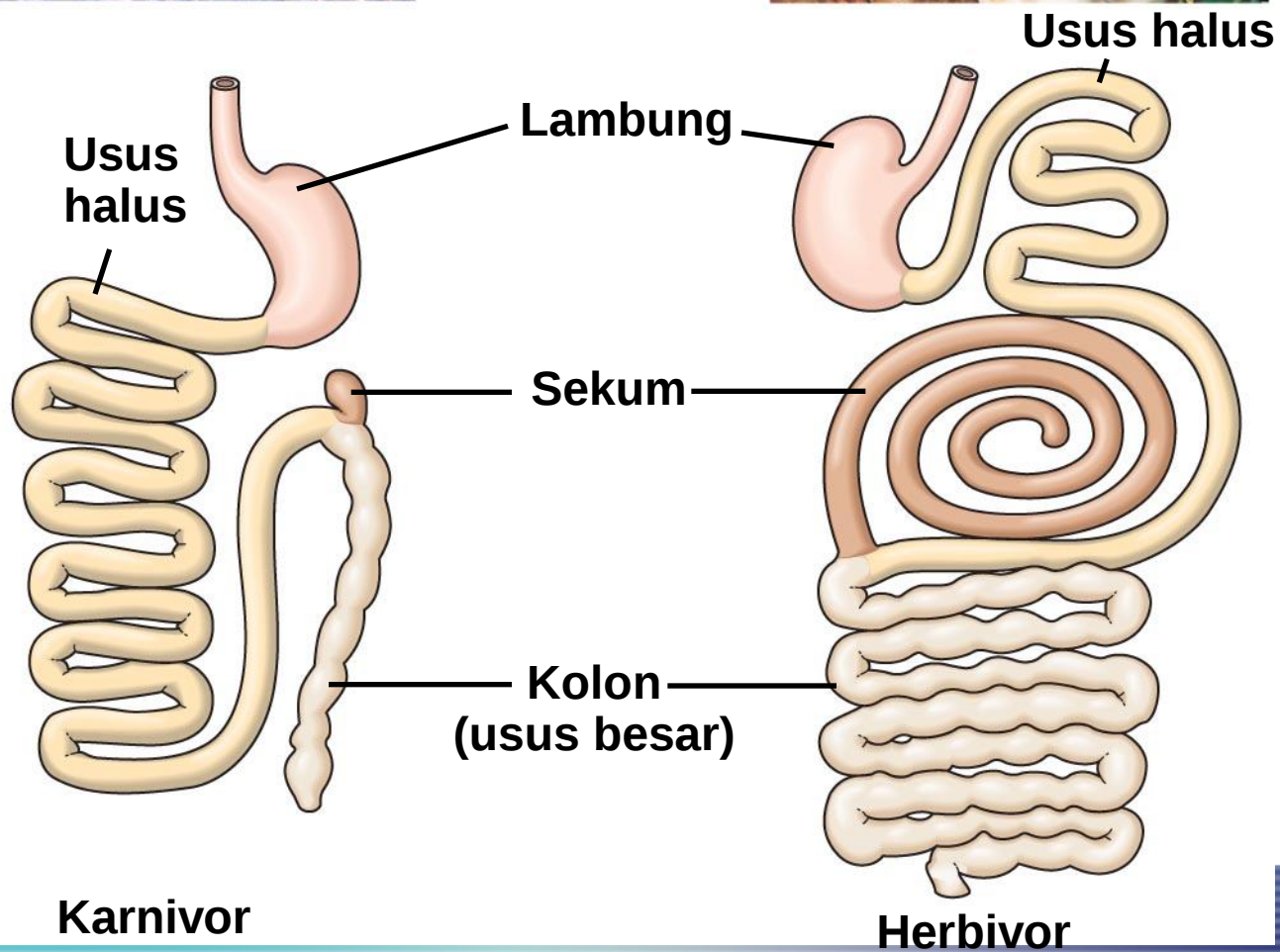
(b) Herbivora



(c) Omnivora

Adaptasi Lambung dan Usus

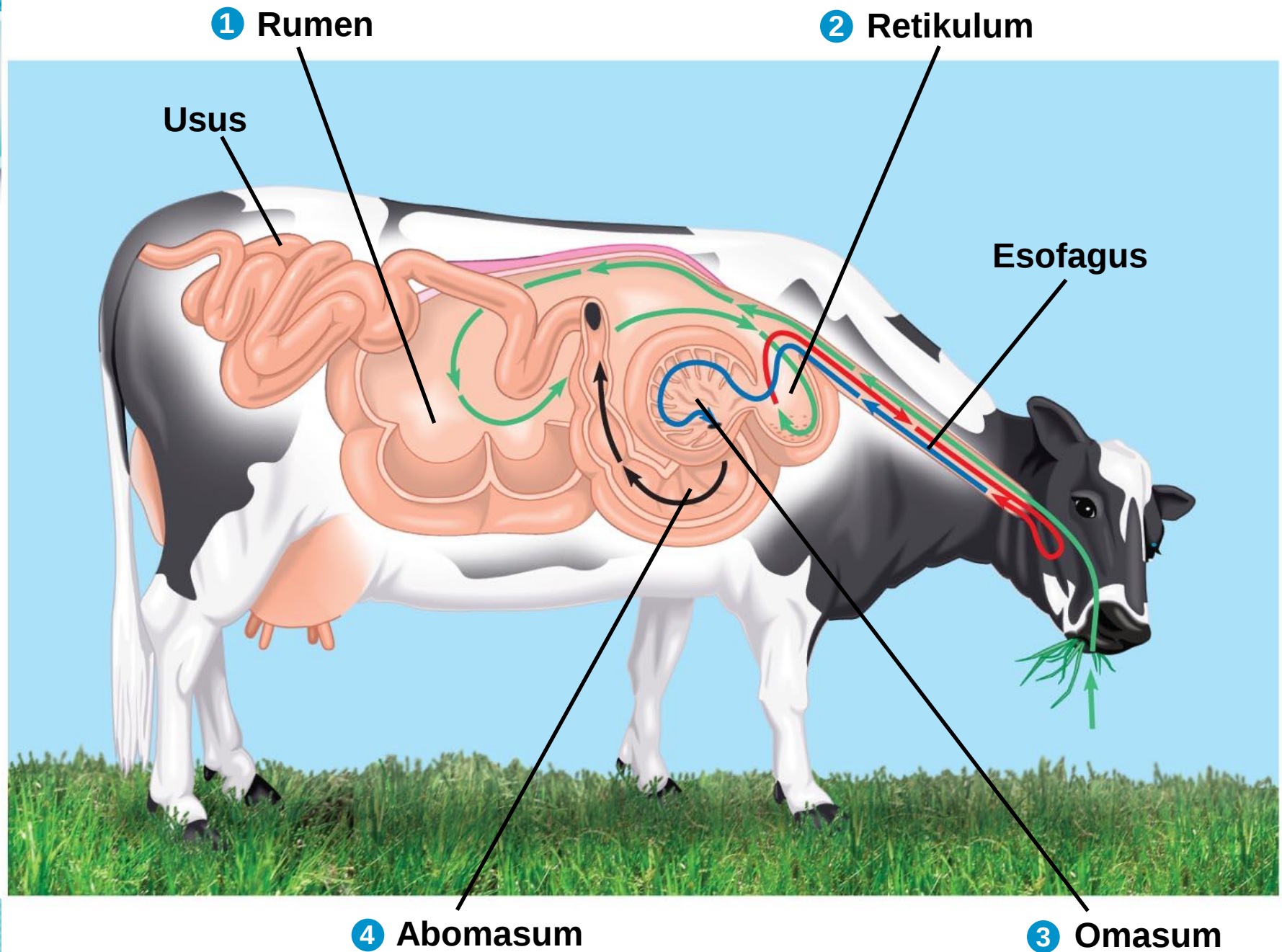
- Secara umum, herbivor memiliki kanal alimentaris yang lebih panjang dibandingkan karnivor karena dibutuhkan waktu yang lebih lama untuk mencerna tumbuhan



Adaptasi Mutualistik



- Kebanyakan herbivor memiliki bilik fermentasi, tempat mikroorganisme simbiotik mencerna selulosa
- Adaptasi paling rumit untuk diet herbivor telah dievolusikan pada hewan-hewan yang disebut **ruminansia**

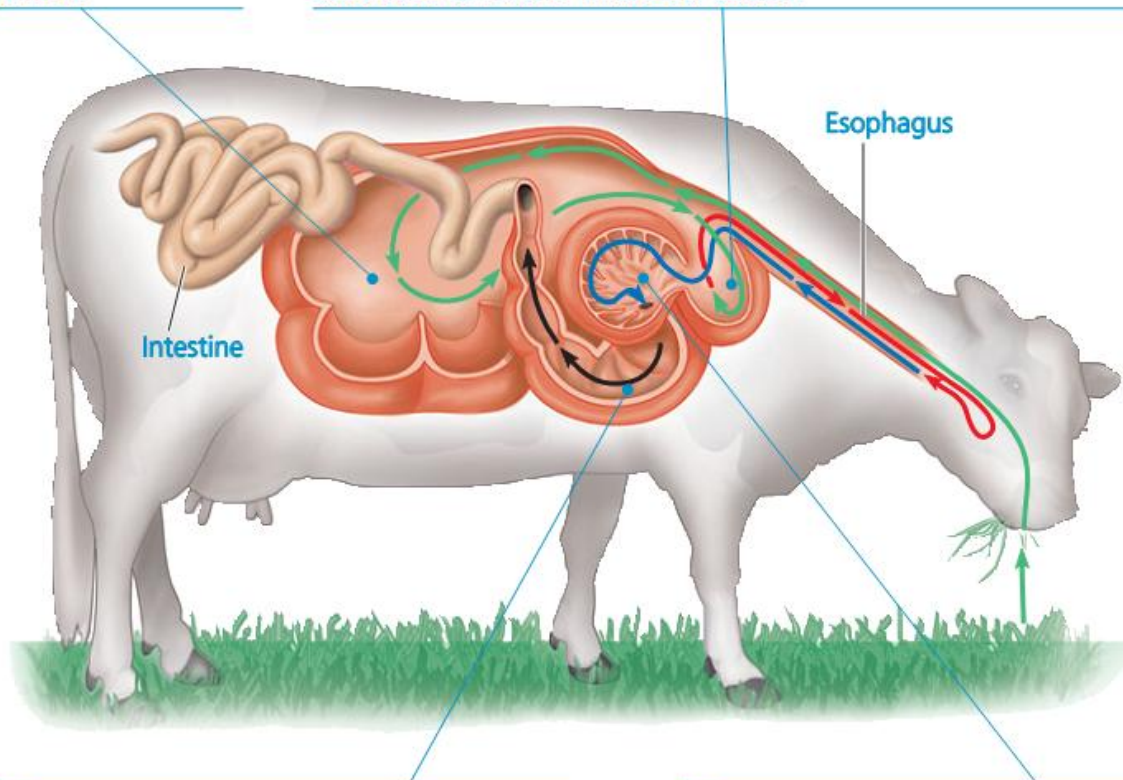


1 Rumen. When the cow first chews and swallows a mouthful of grass, boluses (green arrows) enter the rumen.

2 Reticulum. Some boluses also enter the reticulum. In both the rumen and the reticulum, mutualistic prokaryotes and protists (mainly ciliates) go to work on the cellulose-rich meal. As by-products of their metabolism, the microorganisms secrete fatty acids. The cow periodically regurgitates and rechews the cud (red arrows), which further breaks down the fibers, making them more accessible to further microbial action.

◀ Figure 41.18 Ruminant digestion.

The stomach of a ruminant has four chambers. Because of the microbial action in the chambers, the diet from which a ruminant actually absorbs its nutrients is much richer than the grass the animal originally eats. In fact, a ruminant eating grass or hay obtains many of its nutrients by digesting the mutualistic microorganisms, which reproduce rapidly enough in the rumen to maintain a stable population.



4 Abomasum. The cud, containing great numbers of microorganisms, finally passes to the abomasum for digestion by the cow's own enzymes (black arrows).

3 Omasum. The cow then reswallows the cud (blue arrows), which moves to the omasum, where water is removed.