Glossary

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This glossary includes many of the technical terms that you will encounter in this book. Within each definition all **boldface** terms are defined elsewhere in this glossary. The phonetic spelling in brackets, when given, indicates the pronunciation of a term. The principal stressed syllables are indicated by a prime (‘); other syllables are separated by hyphens (-). The macron (¯) is used for long vowels and the breve (˘) is used for short vowels. The schwa (ə) represents an unstressed neutral vowel. Its sound can vary according to the vowel it represents or the sounds surrounding it (about, item). ä = the vowel sound in “car”; î that in “pier”; ô that in “paw”; ʊ that in “took”; u that in “boot”; û that in “urge”; zh = the “s” in “vision”; th = the “th” in “them”.

For most terms, the classic derivation is given in parentheses because the derivation is descriptive of some aspect of the term and will help you learn and remember it. Because many word roots are repeated in different combinations in other terms, you will soon become familiar with the more common roots. The derivations typically include three components: (1) the language of the original word (Gr. = Greek, L. = Latin); (2) the original word in italics; and (3) the meaning of the original word. Usually only the nominative is given for Greek and Latin nouns, but the genitive (gen.) is included when this is necessary to recognize the root. For Greek and Latin verbs, the original word usually is shown in the first person, singular, present tense because this form of the word is closer to the root term than is the infinitive. The past participle (pp.) or present participle (pres.p.) also is given when this is necessary to recognize the root. The English meaning is given in the infinitive. In some cases, a noun or verb is given in the form it takes when used in combination with other words. This is indicated by a hyphen before or after the word (e.g., odonto- = tooth, as in **odontoblast**).

When the English and classic terms are identical, only the classic meaning is given:

Abducens nerve (L., *abducens*, pres.p. = leading away)

When two or more successive terms use the same root, the derivation is given only for the first one:

Archicerebellum (Gr., *arche* = origin, beginning + L., *cerebellum* = small brain)

Archinephric duct (Gr., *nephros* = kidney)

The origin of many repetitive terms is given under the first entry of the term. For example, ligamentum arteriosum is defined the way this combination of words is used, but the derivation of “ligamentum” and “arteriosum” will be found under the terms “ligament” and “artery.”

Pronunciations, derivations, and definitions of additional terms can be found online.

A

Abdomen [ă’də-mən] (L., *abdomen* = from + *abdo* = to conceal). The part of the body cavity containing the **viscera.**

Abducens nerve [ăb-dŭ’sənz] (L., *abducens,* pres.p. = leading away). The nerve that innervates the lateral rectus **muscle** of the eyeball; cranial nerve 6.

Abductor [ăb’dŭk’tər] (L., *ab-* = prefix meaning away from + *duco,* pp. *ductus,* = to lead). Describes a muscle that abducts or moves a structure away from the midventral line of the body or some other point of reference, e.g., the abductor femoris.

†Acanthodians [ăk-ăn-thō'dē-ənz] (Gr., *akanthodes* = spiny). An extinct group of early **bony fishes** containing the earliest known jawed **vertebrates.** Although commonly called the spiny sharks, they may be more closely related to **bony fishes (Osteichthyes)** than to sharks **(Chondrichthyes).**

Acceleration. The rate of increase in speed, often expressed as meters per second per second.

Accessory nerve. The eleventh cranial nerve of **amniotes,** which innervates the sternocleidomastoid and trapezius complex of muscles.

Acetabulum [ăs'ĭ-tăb'yu-lŭm] (L., = vinegar cup). The socket in the **pelvic girdle** that receives the head of the **femur.**

Acinar [ăs'ĭ-när] (L., *acinus* = berry). A berry-shaped group of glandular cells.

Acoelous vertebra [ā-sē'ləs] (Gr., *a* = without + *koiloma* = hollow). A vertebral body that lacks cavities and is flat on each surface.

Acousticolateralis system [ŭ-kus'tĭ-kō-lăt-ər-ă'lĭs] (Gr., *akoustikos* = related to hearing). The ear and **lateral line system** of **fishes** and larval **amphibians;** also called the octavolateralis system.

Acrodont tooth [ăk'rō-dŏnt] (Gr., *akron* = tip). A tooth that is loosely attached to the crest or inner edge of the jaw.

Acromion [ă-krō'mē-ən] (Gr., *omos* = shoulder). The process on the **scapula** to which the **clavicle** articulates in **species** with a well-developed **clavicle.**

Acrosome [ăk'rō-sōm] (Gr., *soma* = body). The cap at the apex of a **sperm** head that contains enzymes needed for the **sperm** to penetrate the **egg.**

Actinopterygians [ăk'tĭn-ŏp-tə-rĭj'ē-ənz] (Gr., *aktin* = ray + *pteryg-* = fin or wing). A group (Actinopterygii) containing about half of all living **vertebrate species,** or 95% of living **fish species;** the **ray-finned fishes.** See **fish.**

Action potential. The electrical changes that occur across the plasma membrane of **muscle** and **nerve** cells when they become active.

Adaptation. A feature suited for a particular environment or mode of life. Also used to refer to the **evolutionary process** by which organisms became fitted to their environment. Identified retrospectively, this term is often used ambiguously.

Adaptive radiation. A term for a retrospectively identified hypothetical process in which a lineage **speciates** and evolves to occupy different habitats and modes of life.

Adductor [ă-dŭk'tər] (L. *adducere,* pp. = lead to). Describes a **muscle** that adducts, or moves a structure toward the midventral line of the body or other point of reference, such as the adductor mandibulae.

Adenohypophysis [ăd'ə-nō-hī-pŏf'ə-sĭs] (Gr., *aden* = gland + *hypophysis* = under growth). The secretory portion of the **pituitary gland,** or **hypophysis,** that develops as an outgrowth from the **stomodaeum;** secretes **hormones** that regulate pigment production, growth, and the activity of the **thyroid gland, adrenal gland,** and **gonads.**

Adrenal gland [ə-drē'nəl] (L., *ad* = toward + *rene* = kidney). An **endocrine gland** next to the **kidney,** consisting of distinct cortical and **medullary** parts. Major **hormones** of the **cortex** are **cortisol, aldosterone,** and cortical androgen; the major **hormone** of the **medulla** is **epinephrine.**

Adrenaline. See **epinephrine.**

Adrenergic fibers [ăd-rə-nûr'jĭk] (L., *ad* = toward + *rene* = kidney). **Postganglionic sympathetic neurons** that release **noradrenaline (norepinephrine)** at the neuroeffector junctions.

Adrenocorticotropic hormone [ə-drē-nō-kôr'tĭ-kō-trō'pĭk] (Gr., *trophe* = nurture). A **hormone** produced by the **adenohypophysis** that promotes the synthesis and release of adrenocortical **hormones.**

Aestivation. See **estivation.**

Afferent [ăf'ər-ənt] (L., *ad* = toward + *fero* = to carry). Describes structures that travel toward a point of reference, such as **neurons** toward the

central nervous system or **arteries** toward the **gills.**

Agnatha [ăg-nā'thə] (Gr., *a* = without + *gnathos* = jaw). A **nonmonophyletic** group including the jawless **vertebrates** (e.g., **ostracoderms** and **cyclostomes**) with a fossil record extending back over 500 million years and represented today by the living hagfishes and lampreys.

Aldosterone [ăl-dŏs'tər-ōn]. A **hormone** of the adrenal cortex that helps regulate mineral metabolism.

Allantois [ă-lăn'tō-ĭs] (Gr., *allas* = sausage + *eidos* = form). The extraembryonic membrane that develops as an outgrowth of the hind gut. It serves for respiration and **excretion** in **reptile** and bird **embryos,** contributes to the **placenta** in **eutherians,** and forms the **urinary bladder** and part of the **urethra** in adult **amniotes.**

Allocortex [ă-lŏ-kôr'tĕks] (Gr., *allos* = other + L. *cortex* = bark). The part of the **mammalian brain cortex** characterized by three neuronal layers, the **lateral** and **medial pallium.**

Allometry [ă-lŏm'ə-trē] (Gr., *metron* = measure). The study of relative growth in which the proportions of a part of an animal change at a different rate than another part.

Alula [ăl'yu-lə] (L., *ala* = wing + *-ule* = suffix denoting diminutive). The tuft of **feathers** borne by the first digit of a bird's wing.

Alveolus [ăl-vē'ō-ləs] (L., = small pit). A small pit or cavity, such as a tooth socket or a small saclike structure in a **lung,** where gas exchange occurs.

Ameloblasts [ă-mĕl'ō-blăsts] (Middle English, *amel* = enamel + Gr., *blastos* = bud). Cells that secrete **enamel.**

Ammocoete [ăm'ə-sēt] (Gr., *ammocoetes* = something bedded in sand). The **larva** of the lamprey.

Ammonia. The first breakdown product of nitrogen metabolism; very toxic and soluble in water and requires a high water turnover for its elimination; often converted to the less toxic **urea,** and the nontoxic and stable **uric acid.**

Amnion [ăm'nē-ŏn] (Gr., *amnion* = fetal membrane). The innermost of the extraembryonic membranes that surround the **embryo** and encase it in amniotic fluid.

Amniote [ăm'nē-ōt]. A **vertebrate** the **embryo** of which has an **amnion; tetrapods** other than **amphibians.** See **anamniote.**

Amphibians [ăm-fĭb'ē-ənz] (Gr., *amphi* = both, double + *bios* = life). A group of **vertebrates** including frogs, salamanders, and numerous fossil forms. Amphibians usually have aquatic **larvae** and terrestrial adults. See **lissamphibians.**

Amphicoelous vertebra [ăm-fə-sē'ləs] (Gr., *koilma* = hollow). A **vertebral** body that is concave on each surface.

Amphistylic suspension [ăm-fĭ-stī'lĭk] (Gr., *stylos* = pillar). A type of jaw suspension in **fishes** in which the upper jaw is supported by connections to both the **chondrocranium** and **hyoid** arch.

Ampulla [ăm-p'l'ə] (L., = flask), *pl.* **-pullae** [-p'l'ī]. A small, membranous vesicle, such as that on the end of a **semicircular duct.**

Ampullary organ. Ampulla-shaped electroreceptors in the skin of some **fishes** and **amphibians,** such as the **ampullae** of Lorenzini of sharks.

Amygdala [ə-mĭg'də-lə] (Gr., *amygdale* = almond). A deep **nucleus** of **gray matter** in the **cerebral hemisphere;** part of the **lateral pallium** and **limbic system.**

Anagenesis. Evolutionary change that does not involve branching (as opposed to **cladogenesis**). Usually used to refer to gradual changes within a **species** or a lineage. See **cladogenesis, speciation.**

Analogy [ăn-ăl'ə-jē] (Gr., *analogia* = correspondence). A functional similarity among nonhomologous organs. For example, the wing of a butterfly can be considered analogous (but not **homologous**) to the wing of a bird. A type of **homoplasy.**

Anamniote [ăn-ăm'nē-ōt] (Gr., *an* = without + *amnion* = fetal membrane). A **vertebrate** without an **amnion,** such as a **fish** or **amphibian.** Clearly a **nonmonophyletic group** (as in **fish**). See **amniote.**

†Anapsid [ăn-ăp'sĭd] (Gr., *a, an* = without + *apsid* = loop or bar). Without arches; a **vertebrate** skull with a complete roof of **bone** in the temporal region, or a **taxonomic group** of **reptilian species** (†Anapsida) with such a skull type.

Anastomosis [ăn-ăs'tə-mō'sis] (Gr., = opening, outlet). A peripheral union between blood vessels or other structures.

Androgen [ăn'drō-jən] (Gr., *aner,* gen. *andros* = male). A **hormone** that promotes the development of male characteristics.

Anestrus [ăn-ĕs'trəs] (Gr., *oistros* = gadfly, frenzy). The nonbreeding period of sexually mature animals.

Angle of attack. The angle at which the leading edge of a bird's wing is elevated above the horizontal; an increase in angle of attack increases lift up to the stalling point.

Antagonist [ăn-tăg'ə-nĭst] (Gr., *anti* = against + *agona* = contest). A structure, usually a **muscle,** that opposes or resists the action of another.

Antebrachium [ăn-tə-brā'kē-əm] (L., *ante* = before + *brachium* = arm). The forearm.

Anterior chamber. The space within the eyeball located between the **iris** and **cornea.**

Anterior commissure. An **olfactory commissure** within the **cerebrum** located just rostral to the columns of the fornix. See **commissure.**

Antidiuretic hormone [ăn'tē-dī-yu-rĕt'ĭk] (Gr., *anti* = against + *dia* = through + *ouresis* = urination). A **hormone** produced in the **hypothalamus** and stored and released from the **neurohypophysis;** promotes water reabsorption from part of the **kidney** tubule and so concentrates the urine.

Antler [ănt'lər] (L., *ante* = before + *oculus* = eye). One of the **bony,** branching, and **deciduous** horns of members of the deer family; usually restricted to males.

Anura [ăn-y'r'ə] (Gr., *a* = without + *oura* = tail). The **amphibian** taxon to which frogs belong; also called Salientia. Note: "Anura" is a taxon; "anurans" (a vernacular) refers to a group.

Anus [ā'nŭs] (L., = anus). The **caudal** opening of the digestive tract.

Aorta [ā-ôr'tə] (Gr., *aorte* = great artery). A large artery; if unspecified, the dorsal aorta that carries **blood** from the **heart** to the body.

Aortic arches. Embryonic arteries that pass between the pharyngeal pouches as they carry **blood** from the ventral to the dorsal **aorta.**

Apnea [ăp'nē-ə] (Gr., *a* = without + *pnoia* = breathing). The cessation of breathing, during which the breath is held and the **lungs** are not ventilated.

Apomorphic character. A **character** hypothesized to be uniquely derived for (i.e., diagnostic of) a particular **monophyletic taxon.** In evolutionary terms, an **apomorphy** would be a peculiar feature shared by the members of a **monophyletic taxon** that was inherited by each of those members from a hypothetical common ancestor. Some authors divide the term "apomorphy" into two subcategories: "autapomorphy" for terminal **taxa** (distal-most branches of a given **cladogram**), and "synapomorphy" for **monophyletic groups** of **taxa** (branch points of a given **cladogram**). **Synapomorphy** (shared derived **character**) is the most commonly used form. **Synapomorphy** is equivalent to **phylogenetic homology** or derived **character.** Example: the presence of jaws for **Gnathostomata.** See **cladistics, derived character, homology.**

Apomorphy. [ăp'ō-môr-fē]. See **apomorphic character.**

Aponeurosis [ăp'ō-ny'r-ō'sis] (Gr., *apo* = away from + *neuron* = nerve, sinew). A sheetlike **tendon** of a **muscle.**

Appendix (L., *appendere* = to hang upon). A dangling extension of another organ, such as the vermiform appendix on the **caecum.**

Aqueduct of Sylvius (*Franciscus Sylvius,* 1614–16u2, Dutch anatomist). See **cerebral aqueduct.**

Aqueous humor [ā'kwē-ŭs hyu'mer] (L., *aqua* = water + *humor* = liquid). The **lymph**like liquid filling the anterior and posterior chambers of the eye.

Arachnoid [ə-răk'noid] (Gr., *arachne* = spider + *eidos* = form). Tissue surrounding the **central nervous system,** lying peripheral to the **pia mater** and underlying the **dura mater.**

Arbor vitae [är'bər vīt'ē] (L., *arbor* = tree + *vita* = life). The treelike configuration of white fibers entering and leaving the **mammalian cerebellum.**

†Archaeornithes [är'kē-ôr'nə-thēz] (Gr., *arche* = beginning + *oris* = bird). A primitive group of birds, which includes †*Archaeopteryx.*

Archenteron [ärk-ĕn'tər-ŏn] (Gr., *arche* = origin, beginning + *enteron* = intestine, gut). The **embryonic** gut cavity, lined with **endoderm.**

Archicerebellum [är'kē-sĕr-bəl'əm] (Gr., *cerebellum* = small brain). The part of the **cerebellum** that receives vestibular impulses from the ear and impulses from the **lateral line system;** the flocculonodular lobes in **mammals.**

Archinephric duct [är'kə-nĕf'rĭk] (Gr., *nephros* = kidney). The first-formed **kidney duct,** which drains the **kidney** of most **anamniotes** and becomes the ductus deferens of male **amniotes.**

Archinephros. See **holonephros.**

Archipallium. See **medial pallium.**

Archipterygium [är'kē-tə-rĭj'ē-əm] (Gr., *ptery-* = fin or wing). The paired fins of lungfishes in which radials extend from each side of a central **axis;** once believed to be the ancestral morphotype of paired fins.

Archosaurs [är'kō-sôrz] (Gr., *archon* = ruler + *sauros* = lizard). The **reptilian** group (Archosauria) that includes the two extinct orders of dinosaurs, the extinct **†pterosaurs** (†flying **reptiles**), the contemporary crocodiles, and birds.

Arcualia [är'kyu-ā-lē-ə] (L., *arcus* = bow, arch). Small arches of **cartilage** or **bone** that often contribute to the formation of a **vertebra.**

Artery [är'tər-ē] (L., *arteria* = artery). A vessel that carries **blood** away from the **heart.** The **blood** may be high or low in oxygen content.

Articular [är-tĭk'yə-lər] (L., *articulus* = joint). Pertaining to a joint.

Artiodactyls [är'tē-ō-dăk'təlz] (Gr., *artios* = even + *daktylos* = finger or toe). The **mammalian** group (Artiodactyla) that includes **ungulates** with an even number of toes: pigs, deer, cattle.

Arytenoid cartilage [ăr-ə-tē'noid] (Gr., *arytainoeides* = ladle-shaped). The ladle-shaped **cartilage** of the **mammalian larynx** that attaches to and modifies the tension of the **vocal cords.**

Aspiration pumping. A method of **lung** ventilation in which air is sucked into the **lungs;** occurs primarily in **amniotes.**

Astrocytes [ăs'trō-sītz] (Gr., *astron* = star + *kytos* = hollow vessel or cell). Star-shaped nutritive and supportive **glial** cells of the **central nervous system.**

Atlas [ăt'ləs] (Gr. mythology, a god supporting the Earth upon his shoulders). The first **cervical vertebra** of terrestrial **vertebrates,** which articulates with the **skull;** nodding movements of the head occur between the atlas and **skull.**

Atrium [ā'trē-əm] (L., = entrance hall). A chamber, such as the atrium of the **heart,** that receives **blood** from the **sinus venosus** or **veins.**

Atrophy [ăt'rō-fē] (Gr., *a* = without + *trophe* = nourishment). The decrease in size and sometimes loss of a structure.

Auditory [ô'dĭ-tôr-ē] (L., *audio* = to hear). Pertaining to the ear.

Auditory tube. A tube that extends between the **tympanic cavity (middle ear)** and **pharynx** of most **tetrapods** and equalizes the air pressure on both sides of the **tympanic membrane; homologous** to the **spiracle** of **fishes.** Sometimes called the eustachian tube.

Auricle [ô'rĭ-kəl] (L., *auricula* = external ear). The external flap of the mammalian ear. Also, an ear-shaped appendage on the atrium of mammals.

Autonomic nervous system [ô'tə-nŏm'ĭk] (Gr., *autos* = self + *nomos* = law). The part of the nervous system carrying **visceral** motor fibers to the **viscera** and **glands.**

Autostylic suspension [ô'tō-stī'lĭk] (Gr., *stylos* = pillar). A type of jaw suspension in which the upper jaw is attached to the rest of the **skull** by its own processes.

Aves [ā'vēz] (L., = birds). The **vertebrate taxon** that contains the birds.

Axillary [ăk'sə-lĕr-ē] (L., *axilla* = armpit). Pertaining to the armpit: axillary **artery.**

Axis [ăk'sis] (L., = axle, axis). The second **cervical vertebra** of **mammals;** rotary movements of the head occur between the axis and **atlas.**

Axon [ăk'sŏn'] (Gr., = axle, axis). The long, slender process of a **neuron** specialized for the transmission of **nerve** impulses.

Azygos vein [ā-zī'gəs] (Gr., *a* = without + *zygon* = yoke). An unpaired **vein** that drains most of the intercostal spaces on both sides of the **mammalian thorax.**

B

Basal lamina. The thin layer, or **lamina,** of **matrix** that underlies epithelial surfaces; composed primarily of collagen fibrils that do not organize as fibers; formerly called the basement membrane.

Basal nuclei. A group of **nuclei** in the **striatum** of the **mammalian cerebrum.**

Basapophysis [bā'zə-pŏf'ə-sĭs] (Gr., *basis* = base + *apo* = away from + *phys* = growth). A transverse process low on a **vertebral** body to which a subperitoneal rib of a **fish** attaches; serially **homologous** to a **hemal arch.**

Biceps [bī'sĕps] (L., *bi* = two + *ceps* = head). A structure with two heads, such as the biceps **muscle.**

Bicornuate [bī-kôr'nyu-āt] (L., *cornu* = horn). A structure with two **horns,** such as a bicornuate **uterus.**

Bile [bīl] (L., *bilis* = bile). The secretion of the **liver,** containing bile pigments and fat-emulsifying bile salts.

Biped [bī'pĕd] (L., *bi* = two + *pes,* gen. *pedis* = foot). A **tetrapod** that stands upright, such as a human.

Bladder. A membranous sac filled with air or liquid.

Blastocoele [blăs'tō-sēl] (Gr., *blastos* = bud + *koilos* = hollow). A cavity of the **blastula** that becomes obliterated during **gastrulation** and **mesoderm** formation.

Blastocyst [blăs'tō-sĭst] (Gr., *kystis* = bladder). The modified **blastula** of a **eutherian mammal.**

Blastodisk [blăs'tō-dĭsk] (Gr., *diskos* = disk). The disk of cells formed during **cleavage** that lies on the top of the yolk of large-yolked eggs of **fishes** and **reptiles** (including birds) and on the top of the **yolk sac** of **mammals.**

Blastomere [blăs'tō-mîr] (Gr., *meros* = part). One of the cells of the **blastula.**

Blastopore [blăs'tō-pôr] (Gr., *poros* = pore). The opening into the **archenteron** that is formed during **gastrulation.**

Blastula [blăs'tyŭ-lə] (L., diminutive of Gr. *blastos* = bud). The ball of cells formed during **cleavage,** usually containing a **blastocoele.**

Blood. The liquid circulating in the **arteries, capillaries,** and **veins,** consisting of a liquid plasma and cellular elements.

Blood–brain barrier. The structural and physiological barriers that regulate the exchange of materials between the **blood, brain tissue,** and **cerebrospinal fluid.**

Bone. The hard, skeletal material of **vertebrates** that consists of **collagen** fibers to which calcium phosphate crystals are bound, usually arranged in alternating layers of **matrix** and **bone**-forming cells.

Bony fishes. See **osteichthyes.**

Boundary layer. The layer of water or air surrounding a moving aquatic or flying animal in which **shear** forces occur; causes frictional **drag.**

Bowman's capsule. (*Sir William Bowman,* British anatomist, 1816–1892). See **renal capsule.**

Brachial [brā'kē-əl] (L., *brachium* = upper arm). Pertaining to the upper arm; armlike.

Brachium conjunctivum [kŏn-jŭngk-tī'vəm] (L., *conjungo,* pp. *conjunctus* = to join together). The most cranial **cerebellar** peduncle; an armlike **neuronal** tract of **mammals** through which impulses enter and leave the **cerebellum.**

Brachium pontis [pŏn'tĭs] (L., *pons,* gen. *pontis,* = bridge). The middle **cerebellar** peduncle of mammals carrying impulses into the **cerebellum** from the **pons.**

Brain. The enlarged **cranial** portion of the **central nervous system** enclosed by the **cranium;** the major integrative center of the **central nervous system.**

Braincase. The **cartilages** and **bones** that encase the **brain.**

Brainstem. The **brain** exclusive of the **cerebellum** and **forebrain** (**diencephalon** and **cerebrum**).

Branchial [brăng'kē-əl] (Gr., *branchia* = gills). Pertaining to the **gills.**

Branchial arches. Those **visceral arches** (numbers 3–u) that support the **gills** in **fishes.**

Branchiomeres [brang'kē-ō-mērz] (Gr., *meros* = part). The embryonic branchial segments lying between the pharyngeal pouches, including a visceral arch and associated muscle and nerves. Most also contain an **aortic arch.**

Branchiomeric. Pertaining to **muscles** and other structures associated with the **visceral arches.**

Bronchus, pl. **bronchi** [brŏng'kŭs] (Gr., *bronchos* = windpipe). A branch of the **trachea** that enters the **lungs.**

Buccal [bŭk'al] (L., *bucca* = cheek). Pertaining to the mouth, as in *buccal cavity.*

Bulbourethral glands [bŭl'bō-yu-rē'thrəl] (L., *bulbus* = a bulbous root + Gr., *ourethra* = urethra). Accessory sex **glands** of male **mammals** that are located near the base of the **penis** and discharge into the **urethra.**

Bulla [bʊl'ə] (L., = bubble). A bubble-like expansion of some structure, such as the tympanic bulla on the temporal **bone.**

Bunodont [bu'nō-dŏnt] (Gr., *bounos* = mound + *odont-* = tooth). **Molar** teeth with low, rounded cusps.

Bursa [bûr'sə] (L., = purse). A saclike cavity.

Bursa of Fabricius (*Giralamo Fabricius,* Italian anatomist and embryologist, 1533–1619). A dorsal **cloacal** diverticulum of birds, site of the maturation of B lymphocytes.

C

Caecilians [sē-sĭl'ē-ənz] (L., *caecilia* = blindworm). Tropical wormlike burrowing **amphibians** of the **taxon Gymnophiona.**

Caecum [sē'kəm] (L., *caecus* = blind). A blind-ending pouch attached to part of the **intestine,** such as the one at the beginning of the **mammalian** large **intestine.**

Calcaneus [kăl-kā'nē-əs] (L., = heel). The large proximal **tarsal** bone that forms the "heel bone" of **mammals.**

Calcitonin [kăl-sĭ-tō'nĭn] (L., *calx* = lime + Gr., *tonos* = tension). A **hormone** produced by the C cells of the **ultimobranchial bodies** or **thyroid gland;** its actions oppose those of **parathormone,** for it promotes the deposition of calcium in **bone** and reduces its level in the **blood.**

Calyx, pl. **calyces** [kā'lĭks, kāl'ĭ-sēz] (Gr., *kalyx* = cup). A cuplike compartment, such as the **renal** calyces or subdivisions of the **renal** pelvis.

Canaliculi [kăn'ə-lĭk'yu-lī] (L., *canaliculi* = small channels). Small canals in **bone matrix** that contain the processes of the **osteocytes.**

Canine [kā'nīn] (L., *canis* = dog). The **mammalian** tooth behind the **incisors,** usually longer than other teeth.

Cantilever. A projecting beam or other structure that is supported at only one end.

Capillary [kăp'ə-lĕr'ē] (L., *capillus* = hair). One of the minute **blood** vessels between **arteries** and **veins** through which exchanges between the **blood** and **tissue** fluids occur.

Capitulum [kə-pĭch'yə-ləm] (L., = small head). A small, articulating knob on the end of a **bone,** such as a rib.

†Captorhinida [kăp'tō-rī'nĭd-ə] (L., *capus* = capture + Gr., *rhis* = nose). An early, extinct group of primitive **Sauropsida.**

Carapace [kâr'ə-pās] (Spanish, *carapacho* = covering). The dorsal shell of a turtle; the chitinous covering of a crustacean.

Cardiac [kär'dē-ăk] (Gr., *kardia* = heart). Pertaining to the **heart.**

Cardinal vein [kär'dən-əl] (L., *cardinalis* = principal). One of the principal **veins** of **embryonic vertebrates** and adult **anamniotes.**

Carnassials [kär-năs'ē-əlz] (L., *caro,* gen. *carnis* = flesh). The specialized shearing teeth of **carnivores;** the fourth upper **premolar** and first lower **molar.**

Carnivore [kär'nə-vôrz] (L., *-vorous* = devouring). An animal that feeds on other animals.

Carotid [kə-rŏt'ĭd] (Gr., *karotides* = large neck artery, from *karoo* = to put to sleep, because compressing the artery causes unconsciousness). Pertaining to a large **artery** in the neck or to nearby structures.

Carpal [kär'pəl] (Gr., *karpos* = wrist). One of the small **bones** of the wrist.

Cartilage [kär'təl-əj] (Gr., *cartilago* = cartilage). A firm but elastic skeletal **tissue** the **matrix** of which contains proteoglycan molecules that bind with water. Occurs in all **embryos,** in adult **cartilaginous fishes,** and in parts of the skeleton of other **vertebrates** providing firmness as well as flexibility.

Cartilage-replacement bone. Bone that develops within and around the **embryonic endoskeleton.**

Cartilaginous fish. See **chondrichthyes.**

Caudal [kôd'l] (L., *cauda* = tail). Pertaining to the tail.

Caudata [kô'dä-tə]. The **amphibian** group that includes the salamanders.
Cecum. See **caecum.**

Cenozoic. The era of geologic time ranging from about 65 million years before the present to the present.

Center of buoyancy. The point in the body of an aquatic **vertebrate** through which the resultant force of buoyancy acts.

Center of gravity. The point in the body of an animal through which the resultant force of gravity acts.

Central nervous system. That part of the nervous system located in the longitudinal **axis** of the body; consists of the **brain** and **spinal cord.**

Central pattern generator. Groups of **neurons** in the **spinal cord** and **brain** the activity of which is responsible for innate, cyclical movements of body parts, as occur in swimming and walking.

Centrum [sĕn'trəm] (Gr., *kentron* = center). The central part of the **vertebral** complex, lying ventral to the **vertebral** or **neural** arch.

Cephalic [sĕ-făl'ĭk] (Gr., *kephale* = head). Pertaining to the head.

Cephalization [sĕf'ə-lĭ-zā'shən]. The development of a well-defined head.

Cephalochordata [sêf'ə-lō-kôr-dä'tə] (L., *chordata* = string). The **taxon** of **chordates** that includes amphioxus.

Ceratotrichia [sĕr'ə-tō-trĭk'ē-ə] (Gr., *kerat-* = horn + *trich-* = hair). The horny fin rays of **Chondrichthyes.**

Cerebellum [sĕr'ə-bĕl'əm] (L., = small brain). The dorsal part of the **metencephalon,** which is a center for motor coordination.

Cerebral aqueduct [sĕ'rə-brəl] (L., *cerebrum* = brain). The narrow passage within the **brain** that extends between the third and fourth **ventricles;** also called the **aqueduct of Sylvius.**

Cerebral hemispheres (Gr., *hemi* = half + *sphaira* = globe, ball). The pair of hemispheres that form most of the **telencephalon.** They are the major integrating centers of the **brain** in **mammals.**

Cerebrospinal fluid. A **lymph**like fluid that circulates within and around the **central nervous system,** which it helps protect and nourish.

Cerebrum. The two **cerebral hemispheres** of the **brain** in **vertebrates.**

Cervical [sûr'vĭ-kəl] (L., *cervix* = neck). Pertaining to the neck.

Cervix [sûr'vĭks]. The necklike portion of an organ, such as the neck of the **uterus.**

Character. Any feature that is an observable part or attribute of an organism. Congruent **characters** that diagnose groups of organisms are conjectures of **homology,** or **synapomorphies.** See **congruence, homology, synapomorphy.**

Cheek teeth. A collective term for **premolar** and **molar** teeth of **mammals.**

Cheiropterygium [kī-rō-tə-rĭj'ē-əm] (Gr., *chiro-* = hand + *pteryg-* = fin or wing). The paired appendage of a terrestrial **vertebrate.**

Chelonia [kə-lō'nē-ə] (Gr., *chelone* = tortoise). The **taxon** to which turtles belong.

Chimaera [kī-mîr'ə] (Gr., *chimaira* = monster). A **cartilaginous fish** belonging to **Holocephali.**

Choana [kō-ăn'ə] (Gr., *choane* = funnel). One of the paired openings from the **nasal** cavities into the **pharynx;** an internal nostril.

Chondrichthyes [kŏn-drĭk'thĭ-ēz] (Gr., *chondros* = cartilage + *ichthyos* = fish). The **cartilaginous fishes,** including sharks, skates, rays, and **chimaeras.**

Chondroblast. An early embryonic cell that is destined to produce **cartilage.**

Chondrocranium [kŏn'drō-krā'nē-əm] (Gr., *chondros* = cartilage + *kranion* = skull). **Cartilages** that encase the **brain** and major **sense organs** in **embryos** and the adults of some **vertebrates,** also called the neurocranium.

Chondrocyte [kŏn'drō-sīt] (Gr., *kytos* = hollow vessel or cell). A mature **cartilage** cell; develops from a **chondroblast.**

Chondrosteans [kŏn-drôs'tē-ənz] (Gr., *osteon* = bone). A primitive group of **actinopterygians,** including the contemporary sturgeons and paddlefishes.

Chordamesoderm [kôr'də-mĕz'ō-dûrm]. The longitudinal, mid-dorsal group of **mesodermal** cells that moves into the roof of the **archenteron** during **gastrulation** and gives rise to the **notochord.**

Chordates [kôr'dāts]. The group to which **tunicates, amphioxus,** and **craniates** belong; characterized by having a **notochord** at least at some stage of their life cycle.

Chorion [kô'rē-ŏn] (Gr., *chorion* = skinlike membrane enclosing the fetus). The outermost extraembryonic membrane of **amniotes.**

Choroid [kôr'oid] (Gr., *chorioeides* = like a membrane). The highly vascularized middle **tunic** of the eyeball that lies between the **fibrous tunic** and the **retina.**

Choroid plexus [plĕk'səs] (L., *plexus* = network). The vascular network of the **telachoroidea** that secretes the **cerebrospinal fluid;** it may invaginate into certain ventricles or evaginate into the space around the brain.

Chromaffin cells [krō'mə-fĭn] (Gr., *chromo-* = color + L., *affinis* = affinity). Cells in the **medulla** of the **adrenal gland** of **neural crest** origin that secrete **norepinephrine** and **epinephrine** and have an affinity for chromic stains.

Chromatophore [krō-măt'ə-fôr] (Gr., *phoros* = bearing, from *pherein* = to bear). A **vertebrate** cell of **neural crest** origin that carries pigment or reflective granules.

Cilia [sĭl'ē-ə] (L., *cilia* = hairs). Minute, movable processes of some **epithelial** cells that contain a **characteristic** pattern of nine peripheral and two central **microtubules.**

Ciliary body. A part of the **vascular tunic** of the eyeball that secretes the **aqueous humor** and contains **muscle** fibers used in focusing the eye.

Circadian rhythm [sər-kā'dē-ən] (L., *circa* = about + *dies* = day). A metabolic or behavioral pattern with a cycle of approximately 24 hours.

Cisterna chyli [sĭ-stûr'nə kīl'ē] (L., *cisterna* = an underground reservoir, cistern + Gr., *chylos* = juice). The sac that receives **lymph** from the **viscera** and **caudal** parts of the body.

Clade. A **monophyletic group** (as monophyletic is used here).

Cladistics [klə-dĭs'tĭks] (Gr., *clados* = branch). A method of investigating evolutionary relationships. Cladistics does not generally try to identify specific ancestors but rather attempts to interpret the relative interrelationships among **taxa** by calculating the most efficient (i.e., most **"parsimonious"**) **hierarch-ical** arrangement of an **empirical** data set. The data consist of **characters** thought to be uniquely derived for particular groups (e.g., the presence of **vertebrae** in **vertebrates,** the presence of jaws in **gnathostomes,** the presence of **feathers** in birds). **Congruent** data (**homologies** or **synapomorphies**) and **parsimony** are used to make **cladograms** and **phylogenetic** trees. Cladistics is currently the most widely used method of investigating evolutionary relationships. See **character, congruence, homology, parsimony, synapomorphy.**

Cladogenesis. A process theory of lineage multiplication involving branching (i.e., splitting) and divergence between **species** over time. See **anagenesis, speciation.**

Cladogram. A type of branching diagram that uses a **hierarchical** organization of data to construct a putative **phylogeny** of **taxa.** The **characters** on a cladogram that exhibit **congruence** are thought to be indicative of evolutionary relationship. These **characters** are termed **apomorphies** or **synapomorphies.** For example, **feathers** are thought to be uniquely derived for birds (and their presence in all birds is hypothesized to be due to inheritance from a common ancestor). See **apomorphy, cladistics, hierarchy, monophyletic group, parsimony.**

Clasper. The modified part of the **pelvic** fin of male **chondrichthyan fishes** used to transfer **sperm** to the female.

Clavicle [klăv'ĭ-kəl] (L., *clavicula* = small key, nail). A **dermal bone** of the **pectoral girdle** extending medially from the **scapula** to the **interclavicle** or **sternum.**

Cleavage [klē'vĭj]. The mitotic divisions by which the single-celled **zygote** is converted to a multicellular **blastula** of the same size.

Cleidoic egg [klī-dō'ĭk] (Gr., *kleid-* = clavicle, key). The self-contained eggs of **amniotes** in which a free **larval** stage is bypassed; modified in **viviparous species.**

Cleithrum [klī'thrəm] (Gr., *kleithron* = bar). A bar-shaped **dermal** element of the **pectoral girdle** of some **fishes** and early **tetrapods;** located dorsal to the **clavicle.**

Clitoris [klĭt'ər-ĭs] (Gr., *kleitoris* = hill). The small erectile organ of a female **mammal** that corresponds to the male **glans penis** and **corpora cavernosa penis.**

Cloaca [klō-ā'kə] (L., *cloaca* = sewer). The posterior chamber of most **fishes,** nonmammalian **tetrapods,** and **monotreme mammals** into which the digestive tract and **urogenital** passages discharge.

Coccyx [kŏk'sĭks] (Gr., *kokkyx* = cuckoo). Several fused **caudal vertebrae** of humans; does not reach the body surface but serves for the attachment of certain **muscles.**

Cochlea [kŏk'lē-ə] (L., = snail shell). The snail-shaped part of the **mammalian inner ear,** consisting of the **cochlear duct** and the **scala vestibuli** and **scala tympani.**

Cochlear duct. The **duct** within the **cochlea** that

is a part of the **membranous labyrinth** and contains the receptive cells for sound.

Coelacanths [sē'lə-kănths] (Gr., *koilos* = hollow + *akantha* = spine). A group of **sarcopterygian fishes** with a long diverse fossil record going back several hundred million years but represented today by only a single living species.

Coelom [sē'ləm] (Gr., *koiloma* = a hollow). A body cavity that is completely lined by an **epithelium** of **mesodermal** derivation.

Collagen [kŏl'ə-jən] (Gr., *kolla* = glue + *genos* = descent). A protein produced by **fibroblasts;** forms most of the extracellular fibers of **connective tissues** and skeletal **tissues.** It is composed of ultramicroscopic fibrils that usually are organized into fibers that differ in size among the types of collagen.

Collecting ducts. The small tubules that receive material from the **kidney** tubules and lead to the renal pelvis or urinary duct.

Colliculus, pl. **colliculi** [kə-lĭk'yu-ləs] (L., = little hill). One of the small elevations on the dorsal surface of the **mesencephalon** of **mammals** that is a center for certain optic (superior colliculus) or auditory (inferior colliculus) **reflexes.**

Colon [kō'lən] (Gr., *kolon* = colon). The large **intestine** of **tetrapods** exclusive of the **caecum** and **rectum.**

Columella [kŏl'yə-mĕl'ə] (L., = small column). The single, rod-shaped auditory **ossicle** of nonmammalian **tetrapods** that transmits vibrations from the **tympanic membrane** to the **inner ear;** called the **stapes** in **mammals.**

Commissure [kŏm'ə-sh'r] (L., *commissura* = seam). A band of nervous **tissue,** or a sensory canal, that crosses the midline of the body. Neuronal commissures interconnect comparable structures of the two sides of the **central nervous system.** See **decussation.**

Common bile duct. The principal **duct** carrying **bile** to the **intestine,** formed by the confluence of **hepatic** ducts from the **liver** and, when present, the **cystic duct** from the **gallbladder.**

Compression. A stress that results when two parallel **forces** move toward each other.

Concha [kŏng'kə] (Gr., *konkhe* = seashell). One of several folds within the **mammalian nasal** cavities that increase their surface area; also called a **turbinate bone.**

Condyle [kŏn'dīl] (Gr., *kondylos* = knuckle). Any convexly rounded articular surface, such as the occipital condyles of most **vertebrates** or mandibular condyles of **mammals.**

Congruent. Nonconflicting. Congruent data are those data that fit together **hierarchically,** with no conflict. The degree of congruence is dependent on the percentage of total **characters** in a data set that are congruent with each other. See **hierarchy.**

Conjunctiva [kŏn-jŭngk-tī'və] (L., *conjunctus* = joined together). The **epithelial** layer that lines the eyelids and reflects over the **cornea.**

Connective tissue. A widespread body **tissue** characterized by an extensive extracellular **matrix** of fibers. It connects other **tissues** and supports the body; includes fibrous **tissue,** fat, **cartilage,** and **bone.**

Contralateral. Descriptive of a structure that is located on the opposite side of the body from the point of reference.

Conus arteriosus [kō'nəs är-tîr'ē-ō'səs]. The fourth chamber of the **heart** of most **fishes** that extends between the **ventricle** and the **ventral aorta.**

Convergence. For phylogenetic context, see **homoplasy.** In neuroanatomy, this term refers to multiple neurons or receptor cells projecting to a smaller number of target cells.

Convergent evolution. See **homoplasy.**

Coprodaeum [kŏp-rō-dē'əm] (Gr., *kopros* = dung + *hodaion* = way). The portion of the **cloaca** that receives the feces.

Coprophagy [kŏ-prŏf'ə-jē] (Gr., *phagein* = to eat). The reingestion of feces; characteristic behavior of many rodents and lagomorphs.

Coracoid [kôr'ə-koid] (Gr., *korax* = crow + *eidos* = form). A **cartilage-replacement bone** that forms the posteroventral part of the **pectoral girdle,** reduced to a small process shaped like a crow's beak in **therians.**

Cornea [kôr'nē-ə] (L., *corneus* = horny). The transparent part of the **fibrous tunic** at the front of the eyeball.

Cornua [kôr'nu-ə] (L., = horns). Hornlike processes of a structure, such as the cornua of the **hyoid bone.**

Corpora quadrigemina [kôr'pər-ə kwŏd'rə-jĕm'ə-nə] (L., *corpus,* pl., *corpora,* = body + *quadrigeminus* = fourfold). A collective term for the paired superior and inferior **colliculi** on the roof of the **mesencephalon** of **mammals.**

Corpus callosum [kôr'pəs kə-lō'səm] (L., *callosus* = hard). The large **commissure** interconnecting the two **cerebral hemispheres.**

Corpus cavernosum penis [kăv'ər-nō'səm pē'nəs] (L., *caverna* = hollow place). One of a pair of columns of **erectile tissue** that forms much of the **penis.**

Corpus luteum [lu-tē'əm] (L., *luteus* = yellow). The hard, yellowish body that develops from an **ovulated** follicle and acts as an **endocrine gland.**

Corpus spongiosum penis. A column of **erectile tissue** that surrounds the penile portion of the **urethra.**

Corpus striatum. See **striatum.**

Cortex [kôr'tĕks] (L., = bark). A layer of distinctive **tissue** on the surface of an organ, such as the adrenal cortex or the cerebral cortex.

Cortisol [kôr'tĭ-sôl]. A **hormone** produced by the adrenal cortex that helps regulate carbohydrate metabolism.

Cosmine [kŏz'mēn] (Gr., *kosmios* = well ordered). A type of **dentine** found in certain **bony** scales in which there are **dentine** tubules grouped into radiating tufts.

Cosmoid scale. A thick, **bony** scale with a conspicuous layer of **cosmine,** characteristic of early **sarcopterygians.**

Costal [kŏs'təl] (L., *costa* = rib). Pertaining to the ribs.

Cowper's gland (*William Cowper,* British anatomist, 1666–1u0'). See **bulbourethral gland.**

Cranial kinesis [krĭ-nē'sĭs] (Gr., *kinesis* = movement). Movement of parts of the **skull,** exclusive of the lower jaw, relative to each other, occurs during feeding in many nonmammalian **vertebrates.**

Craniate. [krā'nē-āte] (Gr., *kranien* = skull or braincase). The subgroup of **chordates** in which the **brain** is encased in a **cranium;** includes the hagfishes and **vertebrates.**

Cranium [krā'nē-ŭm]. The **skull,** especially the part encasing the **brain.**

Cremasteric pouch [krē'mə-stĕr'ĭk] (Gr., *kremaster* = suspender). Layers of the body wall that suspend the **testis;** the **scrotal** wall apart from the **skin.**

Cribriform plate [krĭb'rə-fôrm] (L., *cribrum* = sieve + *forma* = shape). The perforated portion of the sphenoid **bone** through which groups of **olfactory neurons** pass.

Cricoid cartilage [krī'koid] (Gr., *krikos* = ring + *eidos* = form). Ring-shaped **cartilage** of the **mammalian larynx.**

Crop. The distal part of the **esophagus** of certain birds, especially grain-eating **species,** that stores food.

Crossopterygians [krôs'ŏp-tə-rĭj'ē-ănz] (Gr., *krossoi* = tassels + *pteryg-* = fin or wing). A collective name sometimes used for three groups of **sarcopterygians: coelacanths, rhipidistians,** and **tetrapods.** Some earlier authors use this term in a **nonmonophyletic** sense by excluding **tetrapods.**

Crus, pl. **crura** [krus, kr'r'ə] (L., = leg). The lower leg, shank, or shin of a **tetrapod.**

Crypt of Lieberkühn (*Johann N. Lieberkühn,* German anatomist, 1u11–1u56). Glandlike **in-**

vaginations from the small **intestine** of **mammals; epithelial** cells multiply here, spread over the **intestinal** lining to replace worn-out cells, and some release digestive enzymes.

Ctenoid scale [tĕn'oid] (Gr., *ktenoeides* = like a cock's comb). A thin, **bony** scale having comblike processes on its posterior margin.

Cupula [kyu'pyə-lə] (L., a small tub). A cup-shaped, jelly-like secretion that caps the group of **hair cells** in a **neuromast.**

Cursorial [kûr-sôr'ē-əl] (L., *cursor* = runner). Pertaining to a **vertebrate** specialized for running.

Cutaneous [kyu-tā'nē-əs] (L., *cutis* = skin). Pertaining to the **skin.**

Cycloid scale [sī'kloid] (Gr., *kyklos* = circle). A thin, **bony** scale having a smooth surface and rounded margins.

Cyclostome [sī'klō-stōm] (Gr., *stoma* = mouth). A **nonmonophyletic group** of convenience used to refer to **Petromyzontiformes** (lampreys) and **Myxiniformes** (hagfishes). Thought to be **nonmonophyletic** by most systematic ichthyologists.

Cystic duct [sĭs'tĭk] (Gr., *kystis* = bladder). The **duct** of the **gallbladder.**

D

Deciduous [dĭ-sĭd'yu-əs] (L., *deciduus* = falling off). Teeth (or other elements) that are shed, e.g., the first set of teeth of a **mammal,** which are replaced by the **permanent teeth.**

Decussation [dĕk'ə-sā'shən] (L., *decusso,* pp. *decussatus* = to divide crosswise in an **X**). The crossing of **neuronal** tracts in the midline of the **central nervous system.** Decussations generally do not connect comparable parts of the two sides of the central nervous system. See **commissure.**

Defecation [dĕf'ĭ-kā'shən] (L., *defaeco,* pp. *defaecatus* = to remove the dregs). The elimination of undigested residue and bacteria from the digestive tract.

Deferent duct [dĕf'ər-ənt] (L., *defero,* pres.p. *deferens* = to carry away). The **sperm duct** of **amniotes, homologous** to the **archinephric duct** of **anamniotes.**

Delamination [dē-lăm'ə-nā'shən] (L., *de* = from + *lamina* = small plate). The splitting off of cells to form a new layer.

Dendrite [dĕn'drīt] (Gr., *dendrites* = relating to a tree). Branching **neuronal** processes that receive **nerve** impulses.

Density. The **mass** or **weight** of a body divided by its volume.

Dentine [dĕn-tēn'] (L., *dens,* gen. *dentis* = tooth). **Bone-**like material that forms the substance of a tooth deep to the superficial **enamel.**

Derived character. A **character** thought to have been uniquely evolved for a particular group (e.g., **feathers** for birds and closely related **species; mammary glands** for **mammals**); also called an **apomorphic** or **synapomorphic character.** See **character, primitive character.**

Dermal bones [dûr'məl] (Gr., *derma* = skin). Superficial **bones** that lie in or just beneath the **skin** and develop from the direct deposition of **bone** in **connective tissue;** also called **membrane bones.**

Dermal denticle [dĕn'tĭ-kəl] (L., *denticulus* = small tooth). A small, toothlike scale often found in the **skin** of **cartilaginous fishes;** also called a placoid scale.

Dermatocranium [dûr-mə-tō-krā'nē-əm] (Gr., *kranion* = skull). The portion of the **skull** composed of **dermal bones.**

Dermatome [dûr'mə-tōm] (Gr., *tone* = a cutting). The lateral portion of a **somite,** which will form the **dermis** of the **skin.**

Dermis [dûr'mĭs]. The dense **connective tissue** layer of the **skin** deep to the **epidermis.**

Deuterostome [du'tə-rō-stōm] (Gr., *deuteros* = second + *stoma* = mouth). The group of **coelomate** animals in which the **stomodaeum** rather than the **blastopore** forms the adult mouth; includes echinoderms and **chordates.**

Diagnose (with regard to **taxa**). To define a group so it can be distinguished from all other groups within a particular **taxon.**

Diaphragm [dī'ə-frăm] (Gr., *dia* = through, across + *phragma* = a partition wall). The membranous and **muscular** partition between the thoracic and the abdominal cavities in **mammals.**

Diaphysis [dī-ăf'ĭ-sĭs] (Gr., *physis* = growth). The shaft of a limb **bone.**

Diapophysis [dī-ə-pŏf'ĭ-sĭs] (Gr., *apo* = away from + *physis* = growth). A transverse process that extends from the **vertebral arch** and receives the tuberculum of a rib.

Diapsid [dī-ăp'sĭd] (Gr., *di-* = two + *apsis* = arch). Pertaining to a **reptilian skull** in which two temporal **fenestrae** and two arches of **bone** are present, or to a **reptile** with such a **skull.**

Diarthrosis [dī'ăr-thrō'sĭs] (Gr., *arthron* = joint). A joint allowing considerable movement between the elements, including a hinge action, sliding, and rotation.

Diastole [dī-ăs'tə-lē] (Gr., = dilation). The period during which the **ventricle** of the **heart** relaxes and fills with **blood.**

Diencephalon [dī'ĕn-sĕf'ə-lŏn] (Gr., *dia* = through, across + *enkephalos* = brain). The region of the **brain** between the **telencephalon** and **mesencephalon,** consisting of the **epithalamus, thalamus,** and **hypothalamus.**

Digit [dĭj'ĭt] (L., *digitus* = digit). A finger or toe.

Digitigrade [dĭj'ĭ-tĭ-grād] (L., *gradus* = step). Walking with the heel and ankle raised off the ground so only the **digits** bear the body weight.

Diphycercal tail [dĭf'ĭ'sûr'kəl] (Gr., *diphyes* = twofold + *kerkos* = tail). A **caudal** fin in which the **vertebral axis** is straight and divides the fin margin into roughly symmetrical upper and lower lobes.

Diphyodont [dī-fī'ə-dŏnt] (Gr., *di-* = two + *phyo* = to produce + *odont-* = tooth). Pertaining to **mammals** with two sets of teeth, **deciduous** and **permanent.**

Diplospondyly [dĭp'lō-spŏn'də-lē] (Gr., *diploos* = double + *spondylos* = vertebra). A condition in which two **vertebral** centra per body segment are present; found in some early **tetrapods** and the **caudal** region of some **fishes.**

Dipnoan [dĭp'nō-ən] (Gr., *di-* + *pnoe* = breath). Lungfish.

Divergence. In neuroanatomy, a neuronal pathway that projects to many targets.

Dorsal pallium [păl'ē-əm] (L., *pallium* = cloak). The dorsal-most part of the **pallium,** forms the **isocortex** in **mammals.**

Drag. The resistance to the movement of an animal through the water or air in which it lives.

Duct [dŭkt] (L., *ductus* = conveyance, channel). A small, tubular passage.

Duct of Cuvier (*Baron Georges Cuvier,* 18th-century French scientist). The common **cardinal vein.**

Ductus arteriosus [dŭk'təs är-tîr'ē-ō'səs]. The dorsal part of the sixth **aortic arch,** may serve as a bypass of the **lungs** in **larval** or fetal stages.

Ductus venosus [və'nō'səs]. An **embryonic** connection between the umbilical **vein** and the **caudal vena cava;** bypasses the hepatic **sinusoids.**

Duodenum [du'ō-dē'nəm] (L., *duodeni* = 12 each). The first portion of the **tetrapod** small **intestine,** which is 12 fingerbreadths long in humans.

Dura mater [d'r'ə mā'tər] (L., = hard mother). The dense outer **meninx** surrounding the **mammalian central nervous system.**

E

Ear [ēr] (Anglo-Saxon, *eare* = ear). The organ of hearing.

Ectoderm [ĕk'tō-dûrm] (Gr., *ektos* = outside + *derma* = skin). The outermost of the three **embryonic germ layers;** forms the **epidermis, nervous system,** and **neural crest.**

Ectothermy [ĕk'tō-thûrm-ē] (Gr., *thermos* = heat). A condition in which an animal derives its body heat primarily from the external environment, so its body temperature is about the same as the ambient temperature; also known as **poikilothermy.**

Effector [ĭ-fĕk'tər] (L., = producer). Any organ or cell that responds in some way to a stimulus.

Efferent [ĕf'ər-ənt] (L., *ex* = out + *fero,* pres.p. *ferens* = to carry). Pertaining to structures that carry something away from a point of reference, such as efferent **neurons** leading from the **central nervous system.**

Efferent ductules. Minute, **sperm-**transporting **ducts;** the cords of the **urogenital** union in **anamniotes** and **mesonephric** tubules in the head of the **epididymis** in **amniotes.**

Egest [ē-jĕst'] (L., *egestus* = taken out). The elimination of material from the **caudal** end of the digestive tract; also called **defecation.**

Elasmobranchs [ē-lăz'mō-brangks] (Gr., *elasmos* = thin plate + *branchia* = gills). The **taxonomic group** of **cartilaginous fishes** that includes sharks, skates, and rays.

Electric organ. An organ composed of modified **muscle** or glandular **tissue** that produces electric currents. Electric organs are used for electrolocation, defense, and communication; found primarily in certain fishes.

Electroplaque [ē-lĕk'trō-plăk] (Gr., *electron* = amber, from which electricity can be produced by friction + French, *plaque* = plate). The plates of modified **muscular tissue** that form the **electric organs** of some **fishes.**

Embryo [ĕm'brē-ō] (Gr., *embryon* = ingrowing). An early stage in the development of an organism that is dependent for energy and nutrients on materials stored within itself or obtained from a mother; embryos are not free living.

Empirical. Based on experimental and/or descriptive data.

Enamel [ē-năm'əl] (Middle English, *amel* = enamel). The very hard material on the surface of teeth and some **bony** scales; consists almost entirely of crystals of hydroxyapatite.

Endocrine glands [ĕn'dō-krĭn] (Gr., *endo* = within + *krino* = to separate). Ductless **glands** that discharge their secretions **(hormones)** into the **blood.**

Endoderm [ĕn'dō-dərm] (Gr., *derma* = skin). The innermost of the three **germ layers;** forms the lining of most of the digestive and respiratory tracts and **glandular** cells derived from these structures.

Endolymph [ĕn'dō-lĭmf] (L., *lympha* = liquid). The liquid within the **membranous labyrinth.**

Endometrium [ĕn'dō-mē'trē-əm] (Gr., *metra* = womb). The mucous membrane lining the **uterus.**

Endoskeleton [ĕn'dō-skĕl'ĭ-tn]. The part of the skeleton that lies deep within the body wall, appendages, and **pharynx;** composed of **cartilage** or **cartilage-replacement bone.**

Endostyle [ĕn'dō-stīl] (Gr., *stylos* = pillar). An elongated, **ciliated** groove in the **pharynx** floor of **tunicates** and **amphioxus.**

Endothelium [ĕn'dō-thē'lē-əm] (Gr., *thele* = delicate skin). Delicate **epithelium** lining **blood** vessels and the **heart.**

Endothermy [ĕn'dō-thûr'mē] (Gr., *therme* = heat). A condition in which an animal derives its body heat from internal metabolic processes, so it maintains a high and relatively constant body temperature despite variations in ambient temperature; also known as **homiothermic.**

Enterocoele [ĕn'tə-rō-sēl'] (Gr., *enteron* = gut + *koilos* = hollow). A **coelom** that develops primitively as buds from the gut cavity.

Epaxial [əp-ăk'sē-əl] (Gr., *epi* = upon + *axon* = axle, axis). Pertaining to structures that lie above or beside the **vertebral axis.**

Ependymal epithelium [ĭ-pen'də-məl] (Gr., *ependyma* = garment). The **epithelial** layer that lines the **central nervous system.**

Epiboly [ē-pĭb'ə-lē] (Gr., *epibole* = act of throwing on). The spreading of animal hemisphere cells over vegetal hemisphere cells during the **gastrulation** of some **vertebrates.**

Epidermis [ĕp-ĭ-dûr'mĭs] (Gr., *epi* = upon + *derma* = skin). The **epithelial** layer that forms the surface of the **skin.**

Epididymis [ĕp'ĭ-dĭd'ə-mĭs] (Gr., *didymoi* = testes). A band of **tissue** on the **amniote testis** that is **homologous** to the **cranial** part of the **opisthonephros** and part of the **archinephric duct** of **anamniotes.**

Epiglottis [ĕp'ĭ-glŏt'ĭs] (Gr., *glottis* = entrance to the windpipe). The flap of **fibrocartilage** that deflects food around the entrance of the **mammalian larynx.**

Epimere. See **somite.**

Epinephrine [ep'ə-nef'rin] (Gr., *epi-* = upon + *nephros* = kidney). The **hormone** produced by the adrenal **medulla;** it resembles **norepinephrine** produced by the postganglionic sympathetic **neurons** and it helps the body adjust to stress. Also called **adrenaline.**

Epiphysis [ĭ-pĭf'ĭ-sĭs] (Gr., *physis* = growth). The end of a **mammalian** long **bone;** a threadlike outgrowth from the roof of the **diencephalon** of **cartilaginous fishes.**

Epithalamus [ĕp'ĭ-thăl'ə-mŭs] (Gr., *thalamos* = chamber, bedroom). The roof of the **diencephalon** lying above the **thalamus;** part of it is an **olfactory** center.

Epithelial. See **epithelium.**

Epithelium [ĕp'ĭ-thē'lē-əm] (Gr., *thele* = delicate skin). The delicate cellular **tissue** that covers surfaces and lines cavities. **Epithelial,** *adj.*

Epoöphoron [ĕp'ō-ŏf'ə-rən] (Gr., *oon* = egg + *phero* = to bear). A **vestigial** organ near the **ovary** of **amniotes** that is **homologous** to the male **epididymis.**

Erectile tissue. A **tissue** containing cavernous vascular spaces that swell when they become filled with **blood.**

Esophagus [ĭ-sŏf'ə-gəs] (Gr., *oisophagos* = gullet). The part of the digestive tract between the **pharynx** and **stomach,** or between the pharynx and **intestine** if a **stomach** is absent.

Estivation (also aestivation) [ĕs'tə-vā'shən] (L., *aestivus* = summer). A period of inactivity and dormancy during periods of hot, dry weather.

Estradiol [ĕs'trə-dī'ôl]. The primary **hormone** produced by the **ovarian follicle;** promotes the development of female secondary sex **characteristics** and the development of the **uterine** lining during an **ovarian** cycle. Its feedback to the **hypothalamus** promotes the **luteinizing hormone** surge needed for **ovulation** in many **mammals.**

Estrus [ĕs'trəs] (Gr., *oistros* = gadfly, frenzy). A period in some female **mammals** of increased sexual excitement about the time of **ovulation** during which copulation may occur.

Euryapsid [y'r'ē-ăp'sĭd] (Gr., *eurys* = wide + *apsis* = arch). Pertaining to a **reptilian** skull in which a single temporal **fenestra** is present high on the skull and a wide arch of **bone** beneath it; a **taxonomic group** (Euryapsida) of **reptilian species** with such a **skull** type.

Eustachian tube (*Bartolomeo Eustachio,* a 16th-century Italian anatomist). See **auditory tube.**

Eutherians [yu-thîr'ē-ənz] (Gr., *eu* = true, good + *therion* = wild beast). The group of **therian mammals** with a relatively long **gestation period;** the **placental mammals.**

Evagination [ĭ-văj'ə-nā'shən] (L., *e* = out of + *vagina* = sheath). An outgrowth from another structure, or the process that gives rise to the outgrowth.

Evolution. Unidirectional (noncyclic) change.

Evolutionary homology. Fundamentally similar parts in different organisms that have evolved from a common precursor in an ancestral **species;** they may or may not resemble each other superficially or functionally.

Evolutionary process. A historical causal explanation for the apparent orderliness and systematic patterns of the biological world.

Excretion [ĕk-skrē'shən] (L., *ex* = out + *cretus* = separated). The elimination of nitrogenous wastes.

Exocrine glands [ĕk'sō-krĭn] (Gr., *ex* = out + *krino* = to separate). **Glands** the secretions of which are discharged through a **duct** onto some surface or into a cavity.

Extension [ĭk-stĕn'shən] (L., *tendere* = to stretch). A movement that carries a distal limb segment away from the next proximal segment, retracts a limb at the shoulder or hip, or moves the head or a part of the trunk toward the mid-dorsal line.

External acoustic meatus [ə-ku'stĭk mē-ā'təs]. The external **ear** canal of **amniotes** extending from the body surface to the **tympanic membrane.**

External nostrils. See **nares.**

Extrinsic [ĭk-strĭn'sĭk] (L., *extrinsicus* = from without). Acting from outside the organ in question; applied to **muscles** that are not within or a part of the organ to which they attach.

Extrinsic ocular muscles [ŏk'yə-lər]. The group of small **muscles** that extend from the wall of the **orbit** to the eyeball and control the movements of the eyeball.

F

Facial [fā'shəl] (L., *facies* = face). Pertaining to the face; applied to **muscles,** the seventh **cranial nerve,** and other structures.

Facial nerve. The seventh **cranial nerve;** innervates facial and other **muscles** associated with the second **visceral arch,** some **salivary glands,** and taste receptors on the front of the **tongue.**

Fallopian tube. (*Gabriele Fallopio,* 16th-century Italian anatomist). See **uterine tube.**

Falx cerebri [fălks sĕr'ə-brē] (L., *falx* = sickle + *cerebrum* = brain). The sickle-shaped fold of **dura mater** that projects between the **cerebral hemispheres.**

Fascia [făsh'ē-ə] (L., = band, bandage). Sheets of **connective tissue** that lie beneath the **skin** (superficial fascia) or ensheathe groups of **muscles** (deep fascia or perimysium).

Fasciculus [fă-sĭk'yə-ləs] (L., = small bundle). A small bundle of **muscle** or **nerve** fibers.

Feathers [fĕ*th*'ərz] (Old English, *fether* = feather). **Skin** derivatives, characteristic of birds, that consist primarily of keratinized **epidermal** cells, provide insulation, and form the flying surfaces of the wing and tail.

Femur [fē'mər] (L., = thigh). The thigh or the **bone** within the thigh.

Fenestra [fə-nĕs'trə] (L., = window). A relatively large opening, such as a temporal fenestra in the **skull.**

Fenestra cochleae [kŏk'lē-ē] (L., *cochlea* = snail shell). The opening in the wall of the **otic capsule** through which pressure waves are released from the **cochlea** to the **tympanic cavity;** also called the **round window.**

Fenestra vestibuli [vĕ-stĭb'yə-lē] (L., *vestibulum* = antechamber). The opening in the wall of the **otic capsule** through which vibrations of the **auditory ossicles** establish pressure waves in the **cochlea;** also called the **oval window.**

Fibroblast [fī'brō-blăst] (L., *fibra* = fiber + Gr., *blastos* = bud). An irregularly shaped **connective tissue** cell that produces the extracellular **matrix,** including **collagen** fibers.

Fibrocartilage. A variety of **cartilage** composed mainly of fibers similar to **connective tissue** fibers that sometimes is found in **bone** grooves and articulations.

Fibrous tunic [tu'nĭk] (L., *tunica* = coat). The dense **connective tissue** forming the outer layer of the eyeball; divided into the transparent **cornea** and opaque **sclera.**

Fibula [fĭb'yə-lə] (L., = buckle). The slender **bone** on the lateral side of the shin of **tetrapods.**

Filtration [fĭl-trā'shən]. The nonselective passage of molecules in the **blood,** other than plasma proteins, from the **glomerulus** into the **renal tubule.**

Fish. A **nonmonophyletic group** name of convenience commonly used for **vertebrates** other than **tetrapods.** Among living **vertebrates,** this includes **lungfishes,** the **coelacanth,** cartilaginous fishes (e.g., sharks, batoids, and **holocephalians**), and **actinopterygians (ray-finned fishes).** For a single **species** the plural form is fish; for more than one **species,** the plural form is fishes.

Fissure [fĭsh'ər] (L., *fissura* = cleft). A deep groove or cleft in certain organs, such as the **brain** and **skull.**

Flexion [flĕk'shən] (L., *flexus* = bending). A movement that brings a distal limb segment toward the next proximal segment, advances a limb at the shoulder or hip, or bends the head or a part of the trunk toward the midventral line.

Follicle-stimulating hormone. A **hormone** of the **adenohypophysis** that promotes the development of the **ovarian follicles.**

Foramen, pl. **foramina** [fə-rā'mən, -răm'ə-nə] (L., = opening). A perforation of an organ, usually a small opening.

Foramen magnum [măg'nəm] (L., *magnus* = large). The large opening in the **skull** for passage of the **spinal cord.**

Foramen of Monro (*Alexander Monro Secundus,* 1u59–1808, Scottish anatomist). See **interventricular foramen.**

Foramen of Panizza. An opening between the bases of the left and right systemic arches in crocodilians; shunts **blood.**

Foramen ovale [ō-văl'ē]. A valved opening in the interatrial septum of **fetal mammals** that allows some **blood** to pass from the right to the left **atrium,** thereby bypassing the **lungs;** becomes the adult **fossa ovalis.**

Force. The product of **mass** and **acceleration.**

Forebrain. See **prosencephalon.**

Fornix [fôr'nĭks] (L., = vault, arch). An arch-shaped **neuronal** tract deep in the **cerebrum** that carries impulses from the **hippocampus** to the **hypothalamus.**

Fossa [fŏs'ə] (L., = ditch). A groove or depression in an organ.

Fossa ovalis [ō-vä'ləs]. A depression in the interatrial septum that represents the **fetal foramen ovale.**

Fossorial [fŏ-sôr'ē-əl] (L., *fossorius* = adapted for digging). Descriptive of an animal adapted for digging, such as a mole.

Fovea [fō'vē-ə] (L., = a pit). A small depression, such as the fovea in the **retina** that contains a concentration of cones.

Friction. The resistance to motion of an object resulting from its contact with the surface on which it is moving or the medium through which it is moving.

Frontal [frŭn'tl] (L., *frons,* gen. *frontis* = forehead). Pertaining to the forehead, such as the frontal **bone.**

Fulcrum [f'l'krem] (L., = bedpost). The point of rotation or pivot in a **lever** system.

Funiculus [fy'-nĭk'yə-ləs] (L., = slender cord). A bundle or column of **white matter** in the **spinal cord.**

Furcula [fûr'kyə-lə] (L., = small fork). The united **clavicles** or wishbone of a bird.

Fusiform [fyu'zə-fôrm] (L., *fusus* = spindle + *forma* = shape). A spindle-shaped or streamlined object.

G

Gait. The repetitive sequence for moving and placing the feet on the ground during locomotion of **tetrapods.**

Gallbladder [gôl'blăd-ər] (Old English, *galla* = bile). A small sac attached to the **liver** in which **bile** accumulates before its discharge into the **intestine.**

Gamete [găm'ēt] (Gr., *gamet-* = spouse). The haploid **germ cell:** mature **sperm** or egg.

Ganglion [găng'glē-ŏn] (Gr., = little tumor, swelling). A group of **neuron** cell bodies that lie

peripheral to the **central nervous system** in **craniates.**

Ganoid scale [găn'oid] (Gr., *ganos* = sheen). A **bony** scale with a thick layer of surface **ganoine,** characteristic of the scales of early **actinopterygians.**

Ganoine [găn'ō-ən]. Enamel or enamel-like material deposited in layers on the surface of some **bony** scales.

Gastralia [găs-trā'lē-ə] (Gr., *gaster* = stomach). Riblike structures in the ventral abdominal wall of some **reptiles.**

Gastric [găs-trĭk] (Gr., *gaster* = stomach). Pertaining to or resembling the **stomach**.

Gastrulation [găs-tru-lā'shən] (Gr., *gastrula* = little stomach). The process by which a single-layered **blastula** is converted into a two-layered **gastrula** with an **archenteron; mesoderm** formation often accompanies gastrulation.

Gear ratio. An expression of the relationship between **force** and **velocity;** determined by dividing the **length** of the **out-lever** by the length of the **in-lever.**

Genus name [je'nəs] (L., = race). The **taxon** that comprises very closely related **species,** and the first term in the binomial name for a **species.**

Germ layers (L., *germen* = bud). The three **epithelial tissue** layers **(ectoderm, mesoderm, endoderm)** in an early **embryo** from which all organs will arise.

Gestation period. The period in which the young are carried in the **uterus** before birth; from conception to birth.

Gills. The respiratory organs of aquatic **vertebrates,** consisting of platelike or filamentous outgrowths from a surface across which water flows.

Girdles. The skeletal elements in the body wall that support the **pectoral** and **pelvic** appendages.

Gizzard [gĭz'ərd] (Old French, *gezier* = gizzard). A **muscular** compartment of the **stomach** that usually contains swallowed stones with which food is ground up.

Gland [glănd] (L., *glans* = acorn). A group of **secretory** cells.

Glans clitoridis [glănz klĭ-tôr'ĭ-dĭs] (Gr., *kleitoris* = hill). The small mass of **erectile tissue** at the distal end of the **clitoris** of a female **mammal.**

Glans penis [pē'nəs] (L., *penis* = tail, penis). The bulbous distal end of the **penis** of a **mammal.**

Glenoid fossa [glĕn'oid] (Gr., *glene* = socket + *eidos* = form). The socket in the **pectoral girdle** of **tetrapods** that receives the head of the **humerus.**

Glia. See **neuroglia.**

Glide. A controlled descent at a low angle to the horizontal.

Glomerulus [glō-mĕr'yə-ləs] (L., *glomus* = ball). A ball-like network of **capillaries** that is surrounded by the **renal capsule** at the proximal end of a **renal tubule.** Also refers to clusters of short **neurons** and neuron processes among which the **olfactory** neurons terminate.

Glossal [glô'səl] (Gr., *glossa* = tongue). Pertaining to the **tongue;** also used to describe certain **muscles,** such as the genioglossus.

Glossopharyngeal nerve [glô'sō-fə-rĭn-jē-əl] (Gr., *pharynx* = throat). The ninth **cranial nerve,** which innervates **muscles** of the third **visceral arch** and returns sensory fibers from the part of the **pharynx** near the base of a **tongue.**

Glottis [glŏt'ĭs] (Gr., = opening of the windpipe). The opening near the base of the **tongue** that leads from the **pharynx** to the **larynx.**

Glucagon [glu'kə-gŏn] (Gr., *glykys* = sweet). A **hormone** produced by the **pancreatic islet** cells of the **pancreas** that promotes the breakdown of glycogen and the release of sugar from the **liver;** increases **blood** sugar level.

Gnathostomes [năth'ə-stōmz] (Gr., *gnathos* = jaw + *stoma* = mouth). A collective term for all the jawed **vertebrates** (Gnathostomata).

Gonads [gō'nădz] (Gr., *gone* = seed). The **gamete-**producing reproductive organs, the **ovaries** and **testes.**

Graafian follicle [grä'fē-ən] (*Rijnier de Graaf,* Dutch anatomist, 1641–16u3). See **ovarian follicle.**

Grade. An artificial (i.e., **nonmonophyletic**) **taxon.** The term is usually used to indicate a group defined by convergent or primitive characters (e.g., "**mammal-**like **reptiles**" or **"Pisces"** in their traditional usage). Such groups are often defined by "niche adaptation" rather than by geneology. This term is more relevant to paleoecological studies than to evolutionary studies. See **clade.**

Graviportal [grav'i-pōr'tăl] (L., *gravitas* = weight + *portare* = to carry). Pertaining to **appendicular** and other adaptations that support great weight, as in elephants.

Gray matter. Tissue in the **central nervous system** consisting of **neuron** cell bodies and unmyelinated **nerve** fibers.

Gubernaculum [gu'bər-năk'yə-ləm] (L., = small rudder). A cord of **tissue** that extends between the **embryonic testis** of **therian mammals** and the developing **scrotum** and guides the descent of the **testis.**

Gustatory [gŭs'tə-tôr'ē] (L., *gusto,* pp. *gustatus* = to taste). Pertaining to the sense of taste.

Gymnophiona [jĭm'nō-fē'ən-ə] (Gr., *gymnos* = naked + *ophidion* = snake). A **taxon** of tropical **amphibians** that includes the wormlike, burrowing **caecilians.**

Gyrus [jī'rəs] (Gr., *gyros* = circle). One of the folds on the surface of the **cerebrum.**

H

Habenula [hə-bĕn'y'-lə] (L., = small strip). A small, **epithalamic nucleus** with **olfactory** connection.

Hagfishes. See **myxiniformes.**

Hair. A filamentous **skin** derivative of **mammals** that consists primarily of **keratinized epidermal** cells; helps provide insulation. See **epidermis.**

Hair cells. The receptive cells of the **ear** and **lateral line system,** so called because they bear superficial cytoplasmic processes, most of which are modified **microvilli.**

Halecomorphi [hăl'ē-kō-môr'fī] (L., *halec* = herring + Gr. *morphe* = form). The division of the **neopterygians** that includes the living *Amia calva,* and numerous fossil **taxa.**

Hallux [hăl'əks] (Gr., = big toe). The first or most medial **digit** of the foot.

Hard palate. A shelf of **bone** in **mammals** that separates the **oral cavity** from the **nasal** cavities; together with the **soft palate** it forms the **secondary palate.**

Harderian gland (*Johann Harder,* a 1uth-century Swiss anatomist). A tear **gland** present in certain **mammals** and located rostral to and beneath the eyeball; also called the **gland** of the **nictitating membrane.**

Haversian system. See **osteon.**

Head kidney. A group of **pronephric** renal tubules that persists in the adults of hagfishes and some **teleosts.**

Heart. A hollow-chambered **muscular** organ that pumps **blood** through the body.

Heliothermy [hē'lē-ō-thûrm'ē] (Gr., *helios* = sun + *thermos* = heat). The maintenance of a high body temperature by regulation of the body's exposure to the sun; characteristic of many **reptiles.**

Hemal arch [hē'məl] (Gr., *haima* = blood). A skeletal arch on the ventral surface of a **caudal vertebra** that forms a canal around the **caudal artery** and **vein.**

Hemibranch [hĕm'ē-brăngk] (Gr., *hemi* = half + *branchia* = gills). A **gill** of **fishes** with **gill** filaments or **lamellae** present on only one surface of the interbranchial septum, often the first **gill.**

Hemichordate [hĕm'ē-kôr'dāt] (Gr., *chorde* = string). A group (Hemichordata) of marine invertebrates showing some affinity to the **chordates.**

Contains the acorn worms.

Hemopoietic tissue [hē'mō-poi-ĕt'ĭk] (Gr., *haima* = blood + *poietikos* = producing). A **tissue** in which **blood** cells are formed.

Hepatic [hĭ-păt'ĭk] (Gr., *hepar,* gen. *hepatikos* = liver). Pertaining to **blood** vessels, **ducts,** or other structures associated with the **liver.**

Hepatic portal system. A system of **veins** that drain the abdominal digestive organs and lead to **sinusoids** within the **liver.**

Hepatic vein. One of the **veins** that receives **blood** from the **hepatic sinusoids** and leads to the **heart** or **caudal vena cava.**

Herbivore [hûr'bə-vôr] (L., *herba* = herb + *-vorous* = devouring). Animal specialized to feed on plant material.

Hermaphrodite [hər-măf'rə-dīt] (Gr. mythology, the son of Hermes and Aphrodite who became united in one body with a nymph). An animal with both male and female reproductive organs.

Heterocercal tail [hĕ'tə-rō-sûr'kəl] (Gr., *heteros* = other + *kerkos* = tail). A **caudal fin** of **fishes** in which the **vertebral axis** turns upward into an enlarged dorsal lobe.

Heterochrony [hĕ'tər-ō-krō-nē] (Gr., *chronos* = time). A genetic shift in the timing of the development of a body part or process relative to the ancestral condition.

Heterodont [hĕ'tər-ō-dŏnt'] (Gr., *odous, odont-* = tooth). Pertaining to dentition in which the teeth are differentiated and perform different functions, as in **mammals.**

Hibernation. (L., *hibernus* = wintery). The period of torpor in which some **vertebrates** pass the winter.

Hierarchy. An organization of things arranged in order of rank; a pattern of subsets nested within larger sets.

Hindbrain. See **rhombencephalon.**

Hippocampus [hĭp'ə-kăm'pəs] (Gr., = seahorse). The **medial pallium** of **mammals,** which has shifted medially and protrudes into the lateral **ventricle;** part of the **limbic system.**

Holoblastic cleavage [hŏl'ō-blăs'tĭk] (Gr., *holos* = whole + *glastos* = bud). A pattern of **cleavage** in which the **cleavage** furrows pass through the entire egg.

Holocephalians [hŏl'ō-sĭf-ā'lē-ənz] (Gr., *holos* = whole + *kephale* = head). The group of **cartilaginous fishes** that includes the chimaeras.

Holonephros [hŏl'ō-nĕf'rəs] (Gr., *nephros* = kidney). The hypothetical ancestral **vertebrate kidney** consisting of segmented renal tubules that develop along the full length of the **nephric ridge;** also called an **archinephros.**

Homeostasis [hō'mē-ō-stā'sĭs] (Gr., *homoios* = alike + *stasis* = standing). The condition in which a constant internal environment is maintained despite factors that tend to destabilize it.

Homeothermic [hō'mē-ō-thûr'mĭk] (Gr., *homios* = like + *therme* = heat). Pertains to **vertebrates** in which the body temperature remains relatively constant despite variations in ambient temperature; **endothermic.** See **endothermy.**

Homocercal tail [hō'mō-sûr'kəl] (Gr., *homos* = same + *kerkos* = tail). A **caudal fin** that is superficially symmetrical but retains a slight uptilt in the skeleton of the **vertebral axis; characteristic** of **teleosts.**

Homodont [hō'mō-dŏnt] (Gr., *odous, odont-* = tooth). Pertaining to dentition in which all the teeth are essentially alike, differing only in size.

Homologous. To show **homology.**

Homology [hō-mŏl'ə-jē] (Gr., *homologia* = agreement). The use of this term today is variable, and thus confusing, but it generally refers to some aspect of "sameness" (e.g., structures that match each other in origin, position, shape, or composition). Several types of homology have been defined. With regard to systematic **evolutionary** studies, the most commonly used and relevant type is "**phylogenetic** homology." **Phylogenetic** homology is the fundamental similarity among organs in different organisms thought to be the result of their **evolution** from a precursor organ in a common ancestor. Empirically defined, **phylogenetic** homology at its most

taxonomically inclusive level is the equivalent of **synapomorphy.** Also see **serial homology, sexual homology.**

Homoplasy [hō'mō-plā'zē] (Gr., *plastos* = molded). **Morphological** resemblance among organs that are not phylogenetically **homologous.** In an **evolutionary** context, these are similarities that have originated independently with different lineages. A number of authors have attempted to distinguish among different kinds of homoplasy (e.g., parallelism and convergence) based on presumed recency of common ancestry, **adaptation,** and other hypothetical factors, but the authors believe that such a distinction cannot be unambiguously made based on **empirical** grounds. See **analogy, homology.**

Hormones [hôr'mōnz] (Gr., *hormono,* pres.p. *hormon* = to rouse or set in motion). The secretions of the **endocrine glands.**

Horn (Anglo-Saxon, = horn). A **bony** projection from the **skull** of many **ruminants** that is covered by layers of **keratinized epidermis** and is not shed; usually occurs in both sexes.

***Hox* genes.** Short sections of DNA that occur in clusters called homeoboxes; nearly identical sequences have been found in many invertebrate and **vertebrate** groups and regulate the expression of genes that determine the features **characteristic** of each body segment.

Humerus [hyu'mər-əs] (L., = upper arm). The **bone** of the upper arm.

Hyaline cartilage [hī'ə-lĭn] (Gr., *hyalos* = glass). **Cartilage** with a clear, translucent **matrix.**

Hyobranchial apparatus. The group of **visceral arches** that support the **tongue** and **larynx** of **tetrapods;** includes the **hyoid** arch and one or more other arches.

Hyoid [hī'oid] (Gr., *hyoeides* = shaped like the letter *ypsilon* = Y). Pertaining to structures associated with the second **visceral arch,** known as the hyoid arch.

Hyoid apparatus. See **hyobranchial apparatus.**

Hyomandibula [hī'ō-măn-dĭb'yu-lər] (L., *mandibula* = jaw). The dorsal element of the **hyoid** arch of **fishes** that extends from the **otic capsule** to the posterior end of the upper jaw.

Hyostylic suspension [hī'ō-stī'lĭk] (Gr., *stylos* = pillar). A type of jaw suspension in **fishes** in which the upper jaw is attached to the **skull** by the hyomandibula.

Hypaxial [hī-păk'sē-əl] (Gr., *hypo* = under + *axon* = axle, axis). Pertaining to structures that lie ventral to the **vertebral axis.**

Hyperosmotic [hī'pər-ŏz-mŏt'ik] (Gr., *hyper* = above + *osmos* = action of pushing). A condition in which the concentration of osmotically active solutes in the liquid in question is greater than in the comparison liquid.

Hypobranchial [hī'pō-brăng'kē-əl] (Gr., *hypo* = under + *branchia* = gills). Pertaining to **muscles** or other structures located ventral to the **gills.**

Hypocercal tail [hī'pō-sûr'kəl] (Gr., *kerkos* = tail). A **caudal fin** in which the **vertebral axis** turns into an enlarged ventral lobe.

Hypoglossal nerve [hī'pō-glŏs'əl] (Gr., *glossa* = tongue). The 12th **cranial nerve** of **amniotes,** which innervates **muscles** in the **tongue; homologous** to the **hypobranchial nerve** of **anamniotes.**

Hypomere. See **lateral plate.**

Hypo-osmotic [hī'pō-ŏz-mŏt'ik] (Gr., *osmos* = action of pushing). A condition in which the concentration of osmotically active solute in the liquid in question is less than that in the comparison liquid.

Hypophysis [hī-pŏf'ĭ-sĭs] (Gr., *physis* = growth). The pituitary gland. An endocrine organ, consisting of two lobes, which is located at the base of the skull.

Hypothalamus [hī'pō-thăl'ə-məs] (Gr., *thalamos* = chamber, bedroom). The ventral part of the **diencephalon** that lies beneath the **thalamus;** an important center for **visceral** integration.

Hyposodont [hĭp'sō-dŏnt] (Gr., *hypsos* = height + *odont-* = tooth). A high-crowned tooth.

I

Ileum [ĭl'ē-əm] (L., = small intestine; from Gr., *eileo* = roll up, twist). The caudal portion of the small **intestine** of **tetrapods.**

Iliac [ĭl'ē-ăk]. Pertains to structures near or supplying the **ilium,** such as the iliac artery.

Ilium [ĭl'ē-əm] (L., = groin, flank). The dorsal **bone** of the **tetrapod pelvic girdle** that attaches onto the **sacrum.**

Incisor [ĭn-sī'zər] (L., = the cutter; from *incido* = to cut into). One of the front teeth of **mammals** lying rostral to the **canine;** used for cutting or cropping food.

Incongruence. Homoplasy, or characters that do not show congruence with other **character** data. See **congruence, homoplasy.**

Incus [ĭng'kəs] (L., = anvil). The anvil-shaped middle **auditory ossicle** of **mammals, homologous** to the quadrate **bone.**

Induction [ĭn-dŭk'shən] (L., *inductus* = led in). An **embryonic** process whereby a **tissue** causes an adjacent tissue to differentiate in a characteristic way.

Inertia [ĭ-nûr'shə] (L., *iners* = sluggish). The tendency of a body at rest to remain at rest, or of one in motion to remain in motion.

Infundibulum [ĭn'fŭn-dĭb'yə-ləm] (L., = little funnel). A funnel-shaped structure, such as the expansion of the **oviduct** that contains its coelomic entrance; also a ventral **evagination** of the **hypothalamus** that forms the **neurohypophysis.**

Ingest [ĭn-jĕst'] (L., *ingestus* = taken in). To take material into the mouth.

Ingroup. A relative term referring to all **species** within the particular **taxon** of reference (e.g., all **taxa** within the **taxon** being analyzed **phylogenetically**). See **outgroup.**

Inguinal [ĭng'gwə-nəl] (L., *inguen,* gen. *inguinis* = groin). A term used to describe structures in or near the groin.

Inguinal canal. A passage through the body wall of **mammals** that leads from the **abdominal** cavity into the **vaginal** cavity of the **scrotum;** the ductus deferens as well as the **blood** vessels and **nerves** supplying the **testis** pass through it.

In-lever. The **lever** arm through which a **force** is delivered into a **lever** system; it is the perpendicular distance from the line of action of the in-**force** to the **axis** of rotation of the **lever** system.

Innate behavior [ĭ-nāt'] (L., *innatus* = inborn). Those aspects of behavior that are inherited or instinctive and not learned.

Inner ear. That portion of the **ear** that lies within the **otic capsule** of the **skull** and contains the receptive cells for equilibrium and hearing.

Insectivore [ĭn-sĕk'tĭ-vôr] (L., *insectum* = insect + *-vorous* = devouring). An insect-eating animal, specifically the group of **eutherian mammals** that includes the shrews and moles.

Insertion [ĭn-sûr'shən] (L., *insertio* = a planting). That point of attachment of a **muscle** that moves the most when the **muscle** shortens; it is the most distal end of limb **muscles.**

Insulin [ĭn'sŭ-lĭn] (L., *insula* = island). The **hormone** produced by the **pancreatic islets** that decreases **blood** sugar by promoting the uptake of glucose by cells and its conversion into glycogen in **liver** and **muscle** cells.

Integument [ĭn-tĕg'y'-mənt] (L., *integumentum* = covering). The **skin.**

Integumentary skeleton. Hard structures such as plates of dermal **bone, bony** scales, and teeth that develop in or just beneath the skin. (See also **dermal bone.**)

Intercentrum [ĭn'tər-sĕn'trŭm] (L., *inter* = between + Gr., *kentron* = center). The **ventral** body that lies between the **pleurocentra.**

Interclavicle [ĭn'tər-klăv'ĭ-kəl] (L., *clavicula* = small key). The ventromedian element of the **pectoral girdle** that lies between the **clavicles.**

Internal capsule. A sheet of white fibers passing through the **striatum,** which carries most impulses to and from the **cerebral** cortex.

Internal nostrils. See **choanae.**

Interneurons [ĭn'tər-n'r'ŏnz] (L., *inter* = between + Gr., *neuron* = nerve, sinew). **Neurons** within the **central nervous system** that lie between the motor and sensory **neurons.** Their connections are responsible for most of the integrative activity of the **central nervous system.**

Interstitial cells [ĭn'tər-stĭsh'əl] (L., *interstitium* = space between). Cells of the **testis** between the **seminiferous tubules** that produce **testosterone.**

Interstitial fluid. A **lymph**like fluid that lies in the minute spaces between the cells of the body.

Interventricular foramen [ĭn'tər-vĕn-trĭk'ŭ-lər] (L., *ventriculus* = belly + *foramen* = hole). The opening between the lateral **ventricles** and third **ventricle** of the **brain;** also called the **foramen of Monro.**

Intervertebral disk [ĭn'tər-vər'tē-brəl] (L., *vertebratus* = jointed). Disks of **fibrocartilage** that lie between the **vertebral bodies (centra)** of **mammals** and some other **vertebrates.**

Intervertebral foramen. An opening between successive **vertebral arches** through which a spinal **nerve** passes.

Intestine [ĭn-tĕs'tĭn] (L., *intestinus* = the intestine). The portion of the digestive tract between the **stomach** and **cloaca** or **anus;** site of most digestion and absorption.

Intrinsic [ĭn-trĭn'sĭk] (L., *intrinsicus* = on the inside). A structure that is an inherent part of an organ, such as the ciliary **muscles** of the eyeball.

Invagination [ĭn-vă'jə-nā'shən] (L., *in* = into + *vagina* = sheath). An ingrowth or the process that gives rise to an ingrowth.

Involution [ĭn'vō-lu'shən] (L., *involutus* = rolled up). A process that occurs during **gastrulation** of some **vertebrates** by which surface cells roll over the lip of the **blastopore** and move into the **archenteron.**

Ipsilateral [ĭp'sĭ-lăt'ər-əl] (L., *ipse* = the same + *latus* = side). Pertaining to structures on the same side of the body.

Iris [ī'rĭs] (Gr., *iris* = rainbow). The part of the **vascular tunic** of the eyeball that lies in front of the **lens,** with the **pupil** in its center.

Ischium [ĭs'kē-əm] (Gr., *ischion* = hip). The ventral and posterior element of the **pelvic girdle.**

Islets of Langerhans (*Paul Langerhans,* 19th-century German physician). See **pancreatic islets.**

Isocortex [ī'sō-kôr'tĕks] (Gr., *isos* = equal + L., *cortex* = bark). The expanded **dorsal pallium** of **mammals;** characterized by six **neuronal** layers. Sometimes called the neopallium.

Isometric contraction [ī'sō-mĕt'rĭk] (Gr., *metron* = measure). A **muscle** contraction in which **force** is developed but the **muscle** does not shorten.

Iso-osmotic [ī'sō-ŏs-mŏt'ĭk] (Gr., *osmos* = action of pushing). A condition in which the concentration of osmotically active solutes in the liquid in question is the same as in the comparison liquid.

Isotonic contraction [ī'sō-tŏn'ĭk] (Gr., *tonos* = tension). A **muscle** contraction in which the tension developed remains the same and the muscle shortens.

J

Jacobson's organ (*Ludwig L., Jacobson,* 19th-century Danish surgeon and anatomist). See **vomeronasal organ.**

Jejunum [jə-ju'nəm] (L., *jejunus* = empty). Approximately the first half of the **mammalian** postduodenal small **intestine;** usually found to be empty at autopsies.

Jugular veins [jŭg'yŭ-lər] (L., *jugulum* = throat). Major **veins** in the neck of **mammals** that drain the head.

K

Keratin [kĕr'ə-tĭn] (Gr., *keras* = horn). A **horny** protein synthesized by the **epidermal** cells of many vertebrates.

Kidney [kĭd'nē]. The organ that removes waste

products, especially nitrogenous wastes, from the **blood** and produces urine.

Kinetic skull [kĭ-nĕt'ĭk] (Gr., *kinein* = to move). A **skull** in which the upper jaw and palate can move relative to other parts, found in many **fishes,** squamates, and birds.

L

Labia [lā'bē-ə] (L., = lips). Liplike structures.

Labyrinth [lăb'-ə-rĭnth] (Gr., *labyrinthos* = labyrinth). An intricate system of connecting pathways, such as the **membranous labyrinth** of the **inner ear.**

Lacrimal apparatus [lăk'rĭ-məl] (L., *lacrima* = tear). Pertaining to **glands** and associated structures that produce and transport the tears.

Lactation [lăk-tā'shən] (L., *lac* = milk). The production and release of milk.

Lacuna [lə-ku'nə] (L., = pit). A small cavity, such as one in **bone** that contains an **osteocyte.**

Lagena [lə-jē'nə] (Gr., *lagenos* = flask). A posteroventral **evagination** of the **sacculus;** homologous to the **cochlear duct.**

Lamella [lə-mĕl'ə] (L., = small plate). A thin plate or layer of **tissue,** such as the lamellae in **fish gills** where gas exchange occurs.

Laminar flow. The smooth, nonturbulent flow of water or air across the surface of the body.

Lamprey. See **Petromyzontiformes.**

Larva [lär'və] (L., = mask). A free-living developmental stage that is markedly different from the adult.

Larynx [lăr'ĭngks] (Gr., = larynx). A chamber at the entrance to the **trachea;** contains the **vocal cords** in many **tetrapods** other than birds.

Lateral line nerves. A group of six special somatic sensory **cranial nerves** (not numbered) that are found in aquatic anamniotes. These nerves return impulses from the **lateral line system.** They are sometimes considered to be parts of the facial, glossopharyngeal, and vagus nerves, but they have an independent phylogenetic origin and an embryonic origin from neurogenic **placodes.**

Lateral line system. A sensory system of **fishes** and **larval amphibians** that detects low-frequency water disturbances; parts are sometimes modified as **electroreceptors.**

Lateral pallium [păl'ē-əm] (L., *pallium* = cloak). The lateral-most part of the pallium; includes the **amygdala** and primary olfactory cortex (piriform lobe) of **mammals.** Sometimes called the paleopallium.

Lateral plate. The most lateral or ventral portion of the **mesoderm** that contains the **coelomic cavity;** also called the hypomere.

Lemniscus [lem-nis'kŭs] (Gr., *lemniskos* = ribbon). A ribbon- shaped **neuronal** tract ascending from sensory relay **nuclei** to parts of the **thalamus.**

Lens [lĕnz] (L., = lentil). The part of the eyeball that focuses light on the **retina.**

Lepidosaurs [lĕp'ĭ-dō-sôrz] (Gr., *lepsis* = scale + *sauros* = lizard). A group of **diapsid reptiles,** including *Sphenodon,* lizards, snakes, and amphisbaenians.

Lepidotrichia [lĕp'ĭ-dō-trĭk'ē-ə] (Gr., *trich-* = hair). **Bony fin rays** of **fishes** composed of rows of small, tube-shaped segments, thought to be modified scales.

Levers. Rodlike mechanical devices that exert a force by turning about a pivot or fulcrum.

Leydig cells. (*Franz von Leydig,* German anatomist, 1821–1908). See **interstitial cells.**

Lift. An upward force generated by a stream of water or air flowing across a fin or wing. The line of action of the lift **force** is perpendicular to the stream.

Ligament [lĭg'ə-mənt] (L., *ligamentum* = band, bandage). Strong **connective tissue** band that extends between structures, usually skeletal elements; also describes certain **mesenteries.**

Ligamentum arteriosum [lĭg'ə-mĕn'təm är'tîr-ē-ō'səm]. The **connective tissue** band extending between the **pulmonary** artery and **aorta;** a remnant of the **embryonic ductus arteriosus.**

Limbic system [lĭm'bĭk] (L., *limbus* = border). A **brain** region that encircles the **diencephalon** and leads to the **hypothalamus;** includes the **amygdala, hippocampus, fornix,** cingulate **cortex,** and part of the **hypothalamus.** Important in behaviors related to survival of the species, such as feeding and sexual activity.

Lingual [lĭng'gwəl] (L., *lingua* = tongue). Pertaining to the **tongue,** such as lingual **muscles.**

Linnean classification system. A convention of **hierarchical** ranking that allows organization of **taxa** as sets and subsets. Major categories are (in descending order of rank) kingdom, phylum, class, order, family, **genus,** and **species. Species** names are binomial (two-word) names, and all higher categories are one-word names. Additional rank categories between the seven major ranks are available through the use of prefixes, such as "sub-," "super-," "supra-," and "infra-." The rank of tribe is occasionally used as a suprageneric rank, and the word "section" has been used at several different intermediate levels.

Lissamphibians (Gr., *lissos* = smooth + *amphibianz*). A group containing contemporary **amphibians.** See **amphibians.**

Liver [lĭv'ər] (Anglo-Saxon, *lifer* = liver). A large gland that develops from the floor of the **archenteron** just behind the **stomach;** secretes **bile** and processes **blood** brought to it in the **hepatic portal system.**

Loop of Henle (*Friedrich G. J. Henle,* German anatomist, 1809–1885). See **medullary loop.**

Lophodont [lŏf'ə-dŏnt] (Gr., *lophos* = crest + *odont-* = tooth). A **cheek tooth** the cusps of which have united to form ridges.

Lumbar [lŭm'bər, -bär] (L., *lumbus* = loin). Descriptive of structures in the back between the **thorax** and **pelvis,** such as lumbar **vertebrae.**

Lung [lŭng]. One of a pair of respiratory organs of terrestrial **vertebrates** that develops as an outgrowth from the floor of the **pharynx.** Lungs are present in some **fishes** but are sometimes single and develop **caudal** to the **pharynx.**

Luteinizing hormone [lu'tē-ə-nī'zĭng] (L., *luteus* = yellow). A **hormone** produced by the **adenohypophysis** that promotes maturation of **ovarian follicles, ovulation,** and the growth of the **corpus luteum.**

Lymph [lĭmf] (L., *lympha* = clear water). A clear liquid derived from **interstitial fluid** that flows through the lymphatic vessels.

Lymph heart. Muscular sections of lymphatic vessels of some **amphibians** and **reptiles** the contractions of which help propel the **lymph.**

Lymph node. Nodules of lymphatic **tissue** along the course of the lymphatic vessels; the contained lymphocytes respond to invading antigens and initiate immune responses.

M

Macroevolution. (Gr., *makros* = large). Generally used to refer to large-scale **evolutionary** processes or patterns at the species level and above. See **microevolution.**

Macrolecithal [măk'rō-lĕs'ə-thəl] (Gr., *lekithos* = yolk). An egg with a large amount of yolk, found in many **fishes, reptiles,** and birds.

Macrophage [măk'rō-fāj] (Gr., *phagein* = to eat). Large cells that **phagocytose,** or **ingest,** foreign material. See **phagocytosis, ingest.**

Macula [măk'yŭ-lə] (L., = spot). Spot or patch, specifically clusters of **hair cells** in the **sacculus** and **utriculus** of the **inner ear.**

Malleus [măl'ē-ŭs] (L., = hammer). The outermost of the three **mammalian auditory ossicles; homologous** to the **articular bone.**

Mammalia. See **mammals.**

Mammal-like reptiles. A **nonmonophyletic group** name of convenience, commonly used in the past, that contains many groups of extinct **amniotes.** The name is misleading because these **vertebrates** are not **reptiles** at all, but a series of basal lineages more closely related to **mammals** than to crocodiles, lizards, snakes, dinosaurs, and

birds.

Mammals [măm'əlz] (L., *mamma* = breast). The **vertebrate** group (Mammalia) characterized by **mammary glands** and **hair.**

Mammary glands. Cutaneous glands that secrete milk. Unique to **mammals.**

Mandibular arch [măn-dĭb'yŭ-lər] (L., *mandibula* = lower jaw). The first **visceral arch** of jawed **vertebrates.**

Mandibular cartilage. The ventral part of the **mandibular arch;** forms the lower jaw of **cartilaginous fishes.** Sometimes called Meckel's cartilage.

Mandibular gland. A **mammalian salivary gland** that is located near the **caudal** end of the mandible, or lower jaw.

Manus [mā'nəs] (L., = hand). The hand.

Marsupials [mär-su'pē-əlz] (L., *marsupium* = pouch). The pouched **mammals.** See also **metatheria.**

Marsupium [mär-sŭ'pē-ŭm]. The pouch of a **marsupial** in which the young are carried.

Mass. The quantity of material an object contains, usually measured by **weight.**

Matrix [mā'trĭks] (L., = womb, a female set aside for breeding). **1.** The medium in which a substance is embedded, specifically the extracellular material in **connective tissues. 2.** A tabular illustration of **empirical data** arranged in columns and rows.

Meatus [mē-ā'təs] (L., = passage). A passage such as the **external acoustic meatus,** which leads to the **tympanic membrane.**

Meckel's cartilage. (*Johann F. Meckel,* 18th-century German anatomist). See **mandibular cartilage.**

Medial pallium [păl'ē-əm](L., *pallium* = cloak). The medial-most part of the **pallium;** becomes the **hippocampus** of **mammals.** Sometimes called the archipallium.

Mediastinum [mē'dē-ə-stī'nəm] (L., *mediastinus* = medial, from *medius* = middle). The area between the two **pleural cavities** of **mammals** that contains the **pericardial cavity, thymus,** and other structures.

Medulla [mĭ-dŭl'ə] (L., = core, marrow). The central part of an organ, often as opposed to its periphery or **cortex.**

Medulla oblongata. The posterior region of the **brain** that is continuous with the **spinal cord.**

Medullary loop. Portion of the **renal tubule** of **mammals** and some birds and **reptiles** that loops into the **medulla** of the **kidney,** essential in establishing the interstitial salt gradient needed for the production of a concentrated urine. Sometimes called the loop of Henle.

Melanophore [mĕl'ə-nō-fôr'] (Gr., *melas* = black + *-phore* = bearing). A cell of **neural crest** origin in the **skin** that produces and carries the black pigment melanin.

Melanophore-stimulating hormone. See **Melanotropin.**

Melanotropin (L., *trophe* = nourishment). **Hormone** produced by the intermediate part of the **adenohypophysis;** causes the dispersal of melanin granules in some animals. Sometimes called melanophore-stimulating hormone.

Melatonin [mĕl'ə-tō'nĭn] (Gr., *tonos* = stain). A **hormone** produced by the **pineal gland** in inverse proportion to the amount of light received; may be important in regulating sexual development and biorhythms.

Membrane bone. See **dermal bone.**

Membranous labyrinth [mĕm'brə-nŭs]. The sacs and **ducts** of the **inner ear** that are filled with **endolymph** and contain the receptive cells for balance and hearing.

Meninges [mə-nĭn'jēz] (Gr., *meninx,* pl., *meninges* = membrane). **Connective tissue** membranes that surround the **central nervous system,** namely, the **dura mater, arachnoid,** and **pia mater.**

Meniscus [mə-nĭs'kəs] (Gr., *meniskos* = crescent). A crescent-shaped disk of **fibrocartilage** found in some joints, including the knee joint.

Meroblastic cleavage [měr'ō-blăs'tĭk] (Gr., *meros* = part + *blastos* = bud). The partial **cleavage** of **macrolecithal** eggs.

Mesectoderm [měz-ĕk'tō-dûrm] (Gr., *mesos* = middle + *ektos* = outside). **Mesoderm-**like **tissue** in the head of **vertebrates** that arises from **neural crest** cells.

Mesencephalon [měz'ĕn-sĕf'ə-lŏn] (Gr., *mesos* = middle + *enkephalos* = brain). The **midbrain,** which dorsally forms the **optic lobes** or **corpora quadrigemina.**

Mesenchyme [měz'ən-kĭm] (Gr., *enchein* = to pour in). An **embryonic tissue** that consists of star-shaped, wandering cells and gives rise to most adult **tissues,** except for **epithelium.**

Mesentery [měz'ən-tĕr'ē] (Gr., *enteron* = intestine). Any fold of **coelomic epithelium** that suspends **visceral** organs or extends between them, carrying **blood** vessels and **nerves;** in a limited sense, the membrane that suspends the small **intestine.**

Meso- [měz'ō] (Gr., *mesos* = middle). A term that, when combined with the name of a **visceral** organ, denotes a **mesentery** suspending that organ, such as the mesocolon suspending the **colon.**

Mesoderm [měz'ō-dûrm] (Gr., *derma* = skin). The central **germ layer** of an early **embryo;** gives rise to most of the **connective tissue, muscles,** and **blood.**

Mesolecithal [měz'ō-lĕs-ə-thəl] (Gr., *lekithos* = yolk). An egg, such as that of an **amphibian,** with a moderate amount of yolk.

Mesomere. See **nephric ridge.**

Mesonephric duct. See **archinephric duct.**

Mesonephros [měz'ō-nĕf'rəs] (Gr., *nephros* = kidney). An **embryonic kidney** that develops in the central part of the **nephric ridge;** contributes to the adult kidney of **anamniotes** and the **epididymis** of male **amniotes.**

Mesozoic. The era of geologic time ranging from about 230 to 65 million years before the present.

Metacarpal [mĕt'ə-kär'pəl] (Gr., *meta* = after + *karpos* = wrist). One of the skeletal elements in the palm of the hand.

Metamerism [mĕ-tăm'ər-ĭz-əm] (Gr., *meros* = part). The condition in which the body is divided into similar segments.

Metamorphosis [mĕt'ə-môr'fə-sĭs] (Gr., = transformation). The rapid change in form from a **larva** to an adult.

Metanephros [mĕt'ə-nĕf'rōs] (Gr., *nephros* = kidney). The adult **kidney** of **amniotes,** which develops from the **caudal** part of the **nephric ridge.**

Metatarsal [mĕt'ə-tär'səl] (Gr., *tarsos* = sole of the foot). One of the skeletal elements of the sole of the foot.

Metatheria [mĕt'ə-thîr'ē-ə] (Gr., *therion* = wild beast). The group of **therian mammals** that includes the **marsupials.**

Metencephalon [mĕt'ĕn-sĕf'ə-lŏn] (Gr., *enkephalos* = brain). The **brain** region that includes the **cerebellum** and, in birds and **mammals,** the **pons.**

Microevolution. Generally used to refer to small-scale processes of change working at the level of interbreeding groups of organisms (populations). Such processes are thought by evolutionists to represent the mechanisms responsible for **speciation.** See **macroevolution.**

Microglia [mī-krŏg'lē-ə] (Gr., *micros* = small + *glia* = glue). Small **neuroglial** cells of mesodermal origin, some of which are phagocytic. See **phagocytosis.**

Microlecithal [mī'krō-lĕs'ĭ-thəl]. An egg with a small amount of yolk.

Microvilli [mī'krō-vĭl'ī] (L., *villus* = shaggy hair). Minute, nonmotile cytoplasmic processes on the surface of many **epithelial** cells; they greatly increase surface area.

Midbrain. See **mesencephalon.**

Middle ear. That portion of the **ear** of **tetrapods** that usually contains the **tympanic cavity** and one or more **auditory ossicles** that transmits vibrations from the body surface (usually from a **tympanic membrane**) to the **inner ear.**

Middle ear cavity. See **tympanic cavity.**

Modulus of elasticity. A measure of the elastic properties of a material; equals **stress** divided by **strain.** Structures with a low modulus of elasticity are more elastic than ones with a high modulus.

Molar [mō'lər] (L., *mola* = millstone). One of the teeth in the most posterior group of **mammalian** teeth, usually adapted for crushing or grinding.

Moment. The product of a **force** times the perpendicular distance from the line of action of the **force** to an **axis** of rotation; also called a **torque.**

Monophyletic [mŏn'ō-fī-lĕt'ĭk] (Gr., *monos* = single + *phyle* = tribe). See **monophyletic group.**

Monophyletic group. A **taxon** or group of organisms that includes all known descendants of a hypothetical ancestor and no other members. Putatively monophyletic groups are identified by **hierarchies** of special similarities (also referred to as **characters, phylogenetic homologies,** or **synapomorphies**), such as **hair** and **mammary glands** for **mammals, feathers** for birds, jaws for **gnathostomes,** and the presence of **bone** for **osteichthyans.** See **characters, homology.**

Monophyletic taxa. See **monophyletic group** (monophyletic taxa = monophyletic groups).

Monotremes [mŏn'ō-trēmz] (Gr., *monos* = single + *trema* = hole). A group including the extant **prototherians;** includes the platypus and spiny anteater.

Morphogenesis [môr'fō-jĕn'ə-sĭs] (Gr. *morphe* = form + *genesis* = production). The development of form.

Morphological data. Descriptive data based on the anatomy of organisms.

Morphology [môr-fŏl'ō-jē] (Gr., *morphe* = form + *logos* = discourse). The study of structure.

Motor unit. A motor **neuron** and the **muscle** fibers it supplies.

Mucosa [mŭ-kō'sə] (L., *mucosus* = mucous, slimy). The lining of the gut or other **visceral** organs, consisting of **epithelium** and associated **connective tissue.**

Mucus [mŭ'kəs]. (L., = slime). A slimy material produced by some **epithelial** cells that is rich in the glycoprotein mucin. The adjective is mucous.

Muscle [mŭs'əl] (L., *musculus* = muscle). A contractile **tissue** primarily responsible for the movement of an animal or its parts; discrete groups of **muscle** cells with a common origin and insertion.

Myelencephalon [mī'ə-lĕn-sĕf'ə-lŏn] (Gr., *myelos* = core, marrow + *enkephalos* = brain). The most **caudal** region of the **brain;** consists of the **medulla oblongata** and leads to the **spinal cord.**

Myelin sheath [mī'ə-lĭn]. A sheath around most **axons,** composed of lipid materials.

Myocardium [mī'ō-kär'dē-əm] (Gr., *my-* = muscle + *kardia* = heart). The **muscular** layer of the **heart.**

Myoepithelial cells [mĭ'ō-ĕp-ə-thē'lē-əl]. Elongated **epithelial** cells with contractile properties, such as those associated with **sweat glands.**

Myofilaments [mī'ō-fĭl'ə-mənts]. Ultramicroscopic filaments of actin and myosin that form the contractile mechanism of **muscle** cells.

Myoglobin [mī'ō-glō'bĭn] (L., *globus* = globe). A hemoglobin-like molecule in red **muscle.**

Myomere [mī'ō-mîr] (Gr., *meros* = part). A **muscle** segment, usually applied to adult segments.

Myometrium [mī'ō-mē'trē-əm] (Gr., *metra* = uterus). The **muscular** layer of the **uterus.**

Myoseptum [mī'ō-sĕp'təm]. A **connective tissue** septum between **myomeres.**

Myotome [mī'ō-tōm] (Gr., *tome* = cutting). A muscle segment, usually applied to **embryonic** segments.

Myxiniformes [mĭx'ĭn-ə-fôr'mēz] (Gr., *myxa* =

slime + L., *forma* = form). A group of jawless **fishes** including the hagfishes.

N

Nares [nĕr'ēs] (L., *naris,* pl., *nares* = nostrils). The paired openings from the outside into the **nasal** cavities; **external nostrils.**

Nasal [nā'zəl] (L., *nasus* = nose). Pertaining to the nose, as in nasal bone.

Neocerebellum [nē'ō-sĕr-ə-bĕl'əm] (Gr., *neos* = new + L., *cerebellum* = small brain). The portion of the **mammalian cerebellum** that has connections with the **cerebrum;** includes the **cerebellar hemispheres** and part of the **vermis.**

Neocortex. See **isocortex.**

Neognathous birds [nē'ō-nâth-əs] (Gr., *gnathos* = jaw). The group of birds (Neognathae) with a relatively advanced, nonreptilian type of palate; includes most orders of birds. See **paleognathous birds.**

Neonatal [nē'ō-nā'təl] (L., *natus* = born). Newborn.

Neopallium. See **isocortex.**

Neopterygians [nē'ŏp-tə-rĭj'ē-ənz] (Gr., *neos* = new + *pteryg-* = fin or wing). The group of **actinopterygian fishes** that includes gars, bowfins, and **teleosts.**

Neornithes [nē-ôr'nə-thēz] (Gr., *neos* = new + *ornis* = bird). The group of birds that has lost many of the primitive features of the **Archaeornithes** (including the long tail); essentially modern birds.

Neoteny [nē-ŏt'ən-ē] (Gr., *teinein* = to extend). **Paedomorphosis** that results from the slowing down of **somatic** development relative to reproductive development; it occurs in many salamanders.

Nephric ridge [nĕf'rĭk] (Gr., *nephros* = kidney). The region of the **mesoderm** between the **somite** and **lateral plate** that gives rise to the **kidneys** and **gonads;** also called nephrogenic ridge and mesomere.

Nephron [nĕf'rŏn]. A **renal tubule,** the structural and functional unit of the **kidneys.**

Nerves [nûrvz] (L., *nervus* = nerve). A cordlike group of **axons** and associated **connective tissue** that lies outside the **brain** and **spinal cord; nerves** connect the **central nervous system** with other organs of the body.

Neural arch [n'r'əl]. See **vertebral arch.**

Neural crest (Gr., *neuron* = nerve, sinew). A pair of ridges of **ectodermal** cells that develop along the top of the **neural tube** as the neural folds close; this **derived character** of **craniates** gives rise to many of their distinctive features, including the **visceral** skeleton, pigment cells, sensory and postganglionic **neurons,** the **dentine-**producing cells of teeth, and certain **bony scales.**

Neural tube. The tube formed in the **embryo** by the joining of the pair of **neural** folds; the precursor of the **brain** and **spinal cord.**

Neurilemma [n'r'ə-lĕm'ə] (Gr., *lemma* = husk). The thin sheath formed by cells of **neural crest** origin that surrounds an unmyelinated **axon,** or, after having myelinated an **axon,** lies on the surface of the **myelin sheath.**

Neurocranium. See **chondrocranium.**

Neuroectoderm (Gr., *ektos* = outside + *derma* = skin). That portion of the **ectoderm** that gives rise to the **neural tube** and **neural crest.**

Neurogenic placode. See **placode.**

Neuroglia [n'-rŏg'lē-ə] (Gr., *glia* = glue). Cells in the **central nervous system** that help support, protect, and maintain the **neurons;** they include **astrocytes, oligodendrocytes,** and **microglia.**

Neurohemal organ [n'r'ō-hē'məl] (Gr., *haima* = blood). An organ, such as the **neurohypophysis,** formed by the termination of a group of neurosecretory **neurons** and the **blood** vessels into which they discharge their products.

Neurohypophysis [n'r'ō-hī-pŏf'ə-sĭs] (Gr., *hypo* = under + *physis* = growth). The posterior part of the **hypophysis** that develops from the **infundibulum** of the **brain;** its **hormones** promote the reabsorption of water and smooth **muscle** con-

traction.

Neuromast [n'r'ō-măst] (Gr., *mastos* = knoll, breast). An aggregation of sensory **hair cells** and supporting cells in the **lateral line system** that is overlain by a gelatinous **cupula.**

Neuron [n'r'ŏn]. A **nerve** cell, the structural and functional unit of the nervous system.

Neurosecretory cells [n'r'ō-sĭ-krē'-tə-rē]. **Neurons** that secrete **hormones.**

Neurotransmitters [n'r'ō-trănz'mĭt-ərz]. Substances released by **neurons** at **synapses** and neuroeffector junctions that activate or inhibit the target cells.

Nictitating membrane [nĭk'tĭ-tā'tĭng] (L., *nicto,* pp. *nictatus* = to wink). A third eyelid of many **amniotes** that helps protect and cleanse the surface of the eyeball.

Nidamental gland [nī'də-mĕn'təl] (L., *nidamentum* = nesting material). An aggregation of **glands** in the **oviduct** that secrete coverings for the eggs.

Nipple [nĭp'əl] (Old English, *neb* = small nose). A **papilla** that bears the openings of the **ducts** from the **mammary glands.**

Nonmonophyletic. See **nonmonophyletic group.**

Nonmonophyletic group. A group that is not **monophyletic** (see **monophyletic group**). Some authors attempt to divide nonmonophyletic groups into two types (**paraphyletic** and **polyphyletic**), but these subcategories often are defined inconsistently. This distinction is thought here to be relatively unimportant.

Noradrenaline. See **norepinephrine.**

Norepinephrine. [nôr-ep'ə-nef'rin] (L., *nor* = short for normal + Gr., *epi-* = upon + *nephros* = kidney.) The **hormone** produced by **postganglionic** sympathetic **fibers** and by **chromaffin cells** of the **adrenal medulla.**

Notochord [nō'tō-kôrd] (L., *notos* = back + *chorda* = string, cord). A rod of vacuolated cells encased by a firm sheath that lies ventral to the **neural tube** in **vertebrate embryos** and some adults.

Nucleus [nu'klē-əs] (L., = kernel). An organelle within a cell that contains the genetic material; a group of **neuron** cell bodies within the **brain.**

O

Obturator foramen [ŏb'tə-rā'tər] (L., *obturo,* pp. *obturatus* = to stop up). A **foramen** in the **pubis** of **reptiles,** or an opening between the pubis and **ischium** in **mammals;** the obturator **muscles** arise from the periphery of the obturator foramen and close it.

Occipital nerves [ŏk-sĭp'ĭ-təl] (L., *occiput* = back of the head). **Nerves** that emerge from the occipital region of the **skull,** or just behind it, in **fishes** and some **amphibians;** they become the hypoglossal nerve of **amniotes.**

Occlusion [ō-klu'zhən] (L., *occludo,* pp. *occlusus* = to shut up). The closing of a passage; the coming together of the surfaces of the teeth of upper and lower jaws.

Octavolateralis system [ŏk-tā'vō-lăt-ə-rā'lĭs] (L., *octavus* = the eighth + *latus* = side, flank). The combined vestibuloauditory and **lateral line systems** of **fishes** and **amphibians;** fibers from the **ear** return in the eighth **nerve,** and those from the **lateral line system** return in the adjacent **lateral line nerves.** Fibers of the lateral line nerves are closely associated with the seventh, ninth, and tenth **nerves.**

Oculomotor nerve [ŏk'yu-lō-mō'tər] (L., *oculus* = eye + *motorius* = moving). The third cranial **nerve,** which innervates most of the **extrinsic muscles** of the eyeball and carries autonomic fibers into the eyeball.

Odontoblast [ō-dŏn'tō-blăst] (Gr., *odont-* = tooth + *blastos* = bud). Cell of **neural crest** origin that produces the **dentine** of teeth or certain **bony scales.**

Olecranon [ō-lĕk'rə-nŏn] (Gr., *olene* = elbow +

kranion = head). A process on the proximal end of the **ulna** to which the triceps **muscle** attaches.

Olfactory [ōl-făk'tə-rē] (L., *olfacio,* pp. *olfactus* = to smell). Pertaining to the nose.

Olfactory bulb. A rostral enlargement of the **brain** in which the **olfactory nerve** terminates.

Olfactory nerve. The first cranial **nerve,** consisting of **neurons** returning from the nose to the **olfactory bulb.**

Oligodendrocytes [ŏl'ĭ-gō-dĕn'drə-sīts] (Gr., *oligos* = few + *dendron* = tree + *kytos* = hollow vessel or cell). **Neuroglial** cells of **ectodermal** origin that myelinate **axons** in the **central nervous system.**

Omentum [ō-mĕn'təm] (L., = fatty membrane). The **peritoneal** fold, sometimes containing a great deal of fat, which extends between the body wall and **stomach** (greater omentum), or between the **stomach** and **liver** and **duodenum** (lesser omentum).

Omnivore [ŏm'nə-vôr] (L., *omnis* = all + *-vorous* = devouring). An animal that eats a wide variety of food, both plant and animal.

Ontogeny [ŏn-tŏj'ə-nē] (Gr., *on* = being + *genesis* = birth or descent). The development of an individual.

Oogenesis [ō-ō-jĕn'ə-sĭs] (Gr., *oon* = egg). The development and maturation of an egg.

Operculum [ō-pûr'kyə-ləm] (L., = covering). The **gill** covering of **fishes** and some **amphibian larvae** consisting of **bone** and soft **tissue** (the **bone** by itself is referred to as the opercle); also an **auditory ossicle** in contemporary **amphibians.**

Ophthalmic nerve [ŏf-thăl'mĭk] (Gr., *ophthalmos* = eye). One of the main branches of the **trigeminal nerve;** passes through the orbit.

Opisthocoelous vertebra [ō-pĭs'thō-sē'lŭs] (Gr., *opisthen* = behind + *kolima* = hollow). A **vertebral body** that is concave on the posterior or **caudal** surface and convex on the anterior surface.

Opisthonephros [ō-pĭs'thō-nĕf'rəs] (Gr., *nephros* = kidney). The adult **kidney** of most **anamniotes; kidney** tubules are concentrated caudally.

Optic [ŏp'tĭk] (Gr., *optikos* = pertaining to the eyes). Pertaining to the eyes.

Optic chiasm [kī-ăz'mə] (Gr., *chiasma* = cross, from the Greek letter *chi* = X). The complete or partial **decussation** of the **optic nerves** on the floor of the **diencephalon.**

Optic lobes. A pair of enlargements of the roof of the **mesencephalon** that are important integration centers for sight and other senses in **anamniotes.**

Optic nerve. The second cranial **nerve,** which carries impulses from the **retina.**

Oral cavity [ôr'əl] (L., *os,* gen. *oris* = mouth). The mouth cavity, also called the **buccal** cavity.

Orbit [ôr'bĭt] (L., *orbis* = circle, eye). The cavity in the **skull** for the eyeball.

Organ of Corti (*Marquis Alfonso Corti,* Italian anatomist, 1822–1888). The sound receptive organ in the **mammalian cochlea.**

Origin [ôr'ĭ-jĭn] (L., *origio* = beginning). The starting point of a structure; that end of a **muscle** that attaches to the more fixed part of the skeleton, which is the proximal end in limb **muscles.**

Osmosis [ŏs-mō'sĭs] (Gr., *osmos* = action of pushing). The movement of water through a semipermeable membrane, through which solute molecules do not pass, from an area of high water concentration to one with a lower water concentration.

Osmotic pressure. The pressure that results from the movement of water by **osmosis** into a solution surrounded by a semipermeable membrane.

Ossicle [ŏs'ĭ-kəl] (L., *ossiculum* = small bone). Any small bone, such as one of the **auditory** ossicles.

Osteichthyes [ŏs'tē-ĭk'thēz] (Gr., *osteon* = bone + *ichthyes* = fishes). The group of animals in which all or part of the **endoskeleton** ossifies; in-

cludes most **vertebrates.** This term is sometimes also used in a **nonmonophyletic** way excluding **tetrapods.**

Osteoblast [ŏs'tē-ō-blăst] (Gr., *blastos* = bud). A cell that produces the **bone matrix.**

Osteoclast [ŏs'tē-ō-klăst] (Gr., *klastos* = broken). A cell that removes **bone** and calcified **cartilage** during the process of **bone** remodeling and growth.

Osteocyte [ŏs'tē-ō-sīt] (Gr., *kytos* = hollow vessel or cell). A mature **osteoblast** that is surrounded by the **matrix** it has produced.

Osteoderm [ŏs'tē-ō-dûrm] (Gr., *derma* = skin). A small **bone** embedded in the **skin** of some **vertebrates.**

Osteon [ŏs'tē-ən]. A cylindrical unit of **bone** consisting of concentric layers that have developed around a central cavity containing **blood** vessels; also called a haversian system.

Ostium [ŏs'tē-əm] (L., = entrance, mouth). The entrance to an organ, such as the **oviduct.**

Ostracoderms [ŏs-trā'kō-dûrmz] (Gr., *ostrakon* = shell + *derma* = skin). A **nonmonophyletic group** name of convenience applied to several orders of **Paleozoic** jawless fishes that are characterized by the extensive development of **bone** in the **skin.**

Otic capsule [ō'tĭk] (Gr., *otikos* = pertaining to the ear). The portion of the **chondrocranium** that houses the **inner ear.**

Otolith [ō'tō-lĭth] (Gr., *oto-* = ear + *lithos* = stone). A calcareous structure found in the **sacculus** and **utriculus** of **vertebrates;** its movement with respect to gravity stimulates underlying **hair cells** and allows an animal to detect its position and movement.

Outgroup. Any **taxon** outside the **taxon** of reference or study. The closest outgroup is the **sister group.**

Out-lever. The **lever** arm through which a **force** is delivered out of a **lever** system to its point of application; it is the perpendicular distance from the line of action of the out-force to the **axis** of rotation of the **lever** system.

Oval window. See **fenestra vestibuli.**

Ovarian follicles [ō-vĕr'ē-ən] (L., *ovarium* = ovary). Groups of **epithelial** and **connective tissue** cells in the **ovary** that invest and nourish maturing eggs. The mature **follicle** is sometimes calld a **graafian follicle.**

Ovary [ō'və-rē] (L., *ovarium* = ovary). One of a pair of female reproductive organs containing the **ovarian follicles** and eggs.

Oviduct [ō'və-dŭkt] (L., *ovum* = egg + *ducere,* pp. *ductus* = to lead). The tube that carries eggs from the **coelomic** cavity to the outside.

Oviparous [ō-vĭp'ər-əs] (L., *pario* = to bear). A pattern of reproduction in which eggs are laid and then develop outside the body of the mother.

Ovoviviparous [ō'vō-vī-vĭp'ər-əs] (L., *viviparus* = bringing forth alive). A pattern of reproduction in which the eggs are retained within the **uterus** and the **embryos** are born as miniature adults. The term is often limited to aplacental **viviparity,** for all or most of the needed nutrients and energy are contained within the egg.

Ovulation [ŏv'yu-lā'shən]. The rupture of the **ovarian follicle** and the discharge of the eggs from the **ovary** into the **ceolomic** cavity, or sometimes directly into the surrounding infundibulum.

Ovum [ō'vəm] (L., = egg). The mature egg cell.

Oxytocin [ŏk'sĭ-tō'sĭn] (Gr., *okytokos* = swift birth). A **hormone** produced by the **neurohypophysis** that promotes the contraction of **uterine muscles** at birth and the release of milk during **lactation.**

P

Paedomorphosis [pē'dō-môr'fə-səs] (Gr., *paid-* from *pais* = child + *morphe* = shape). The retention of juvenile **characters** into the adult stage.

Palate [păl'ĭt] (L., *palatum* = palate). The roof of the mouth. See **hard palate, soft palate.**

Palatoquadrate cartilage [păl'ə-tō-kwŏd'rāt] (L., *quadratus* = square). The dorsal part of the **mandibular arch.**

Paleocerebellum [pā'lē-ō-sĕr'ə-bĕl'əm] (Gr., *palaios* = ancient 1 *cerebellum* = small brain). The part of the **cerebellum** that receives proprioceptive impulses; the flocculonodular lobes in **mammals.**

Paleognathous birds [pā'lē-ō-năth'əs] (Gr., *gnathos* = jaw). Birds that retain a primitive **reptile-**like palate; the kiwi, emu, ostrich, and similar birds, most of which are flightless.

Paleopallium. See **lateral pallium.**

Paleozoic. An era of geologic time ranging from about 600 to 230 million years before present.

Pallium [păl'ē-əm] (L., *pallium* = cloak). The dorsal portion of the **cerebral gray matter;** most forms a surface **cortex** in **mammals.** See **dorsal pallium, lateral pallium, medial pallium.**

Pampiniform plexus [păm-pĭn'ĭ-fôrm] (L., *pampinus* = tendril + *forma* = shape). A convoluted network of veins in **mammals** that surrounds the spermatic **artery.**

Pancreas [păn'krē-əs] (Gr., *pan* = all + *kreas* = flesh). A large glandular outgrowth of the **duodenum** that secretes many digestive enzymes; also contains the **pancreatic islets.**

Pancreatic islets. Small clusters of endocrine cells in the **pancreas** that produce **hormones** that regulate sugar metabolism; also called the **islets of Langerhans.**

Papilla [pă-pĭl'ə] (L., = nipple). A small, conical protuberance.

Paracrines [para'a-krinz] (Gr., *para* = alongside of + *krino* = to separate). Signalling molecules released by cells that transmit information between cells that are close together, unlike **endocrines,** which transmit messages through the blood between more distant cells.

Paradidymis [pĕr'ə-dĭd'ə-məs] (Gr., *para* = beside + *didymoi* = testes). A small group of **vestigial** mesonephric tubules in mammals located beside the **epididymis** and **testis.**

Paraganglia [pĕr'ə-găng'glē-ə] (Gr., *ganglion* = little tumor). Small groups of **chromaffin cells** that lie beside the sympathetic **ganglia.**

Parallel evolution. See **convergent evolution.**

Parallelism. See **homoplasy.**

Paraphyletic. See **nonmonophyletic group.**

Parapophysis [pĕr'ə-pŏf'ə-sĭs] (Gr., *apo* = away from + *physis* = growth). A transverse process on a **vertebral body** to which the head of a rib attaches, or the facet on a **vertebral body** for such an attachment.

Parasympathetic nervous system [pĕr'ə-sĭm-pə-thĕt'ĭk] (Gr., *syn* = with + *pathos* = feeling). The portion of the **autonomic nervous system** that, in mammals, leaves the **central nervous system** through certain **cranial** and **sacral nerves;** promotes metabolic processes that produce and store energy.

Parathormone [pĕr'ə-thôr'mōn] (Gr., *horma,* pres.p. *hormon* = to rouse or set in motion). The **hormone** of the **parathyroid gland;** helps regulate mineral metabolism.

Parathyroid glands [pĕr'ə-thī'roid] (Gr., *thyreos* = oblong-shaped shield + *eidos* = form). **Endocrine glands** of **tetrapods** located dorsal to or near the **thyroid gland;** their **hormone** regulates calcium and phosphate metabolism.

Paraxial mesoderm. That portion of the **mesoderm** that lies just lateral to the **neural tube,** differentiates into **somites** in the trunk and **caudal** part of the head and into **somitomeres** more rostrally.

Parietal [pə-rī'ə-təl] (L., *paries* = wall). Pertaining to the wall of some structure, such as the parietal **bone** or parietal **peritoneum.**

Parietal eye. A median, photoreceptive eye of some **fishes** and **reptiles;** lies between the **parietal bones.**

Parotid gland [pə-rŏt'ĭd] (Gr., *para* = beside + *otikos* = pertaining to the ear). A **mammalian salivary gland** located **caudal** to the **ear.**

Parsimony. In systematics, this term refers to the

maximum amount of congruence among data. The most parsimonious hypothesis is the one that requires the fewest assumptions (e.g., steps of **character** transformation) about a data set. Parsimony is a necessary methodological tool to empirically select the preferred hypothesis of relationship from a potentially infinite number of possible phylogenetic hypotheses on the basis of **character congruence.** See **congruence.**

Parthenogenesis [pär'thə-nō-jĕn'ĭ-sĭs] (Gr., *parthenos* = virgin + *genesis* = descent or birth). Activation and development of an egg without fertilization.

Patella [pə-tĕl'ə] (L., = small plate). The kneecap.

Pectoral [pĕk'tōr-əl] (L., *pectoralis,* pertaining to the breast; from *pectus* = breastbone). Pertaining to the chest, as in pectoral appendage, pectoral **muscles.**

Pectoral girdle. A series of **bones** or **cartilages** for the attachment of the **pectoral fins** or limbs.

Pelvic [pĕl'vĭk] (L., *pelvis* = basin). Pertaining to basin-shaped structures, such as the human **pelvic girdle,** or to structures near the **pelvic girdle.**

Pelvic girdle. A series of **bones** or **cartilages** for the attachment of the **pelvic fins** or limbs.

†Pelycosaurs [pĕl'ĭ-kō-sôrz] (Gr., *pelyx,* gen. *pelykos* = bowl, axe + *sauros* = lizard). An early group of **synapsids** of questionable **monophyly,** most of which have narrow, deep, axe-shaped skulls.

Penis [pē'nĭs] (L., = tail, penis). The male copulatory organ.

Pericardial cavity [pĕr'ĭ-kär'dē-əl] (Gr., *peri* = around + *kardia* = heart). The portion of the **coelom** that surrounds the **heart.**

Perichondrium [pĕr'ĭ-kŏn'drē-əm] (Gr., *chondros* = cartilage). The **connective tissue** covering of a **cartilage.**

Perilymph [pĕr'ə-lĭmf] (L., *lympha* = a clear liquid). The **lymph**like fluid that surrounds the **membranous labyrinth** of the **inner ear.**

Periosteum [pĕr'ē-ŏs'tē-əm] (Gr., *osteon* = bone). The **connective tissue** covering of a **bone.**

Peripheral nervous system. The portion of the nervous system lying peripheral to the **brain** and spinal cord; the cranial and spinal **nerves.**

Perissodactyls [pə-rĭs'ō-dăk'təlz] (Gr., *perissos* = odd + *daktylos* = finger or toe). The **mammalian** group that includes those **ungulates** with an odd number of **digits** (three or one): the rhinoceros, tapirs, horses.

Peritoneal. Pertaining to the **peritoneum.**

Peritoneal cavity [pĕr'ĭ-tə-nē'əl] (Gr., *peritonaion* = to stretch over). The part of the **mammalian coelom** that surrounds the **viscera.**

Peritoneum [pĕr'ĭ-tə-nē'əm]. The **connective tissue** and **epithelial** layer that lines the **peritoneal cavity,** forms **mesenteries,** and covers the **viscera.**

Permanent teeth. The teeth of **mammals** that replace the milk, or **deciduous,** teeth.

Pes [pĕz] (L., = foot). Foot.

Petromyzontiformes [pĕ'trō-mī'zŏn-tĭ-fôr'mēz] (Gr., *petros* = stone + *myzo* = to suck in + L., *forma* = form). The lampreys.

Phagocytosis [făg'ō-sī-tō'sĭs] (Gr., *phagein* = to eat + *kytos* = hollow vessel or cell). The **ingestion** and breaking down of foreign particles by a cell.

Phalanges [fə-lăn'jēz] (Gr., *phalanx,* pl. *phalanges* = battle line of soldiers). **Bones** of the **digits** that extend beyond the palm or sole.

Pharynx [fĕr'ĭngks] (Gr., = throat). The portion of the digestive tract from which the pharyngeal pouches develop in an **embryo;** lies between the **oral cavity** and **esophagus;** the crossing place of digestive and respiratory tracts.

Pheromones [fĕr'ə-mōnz] (Gr., *pherein* = to bear + *horma,* pres.p. *hormon* = to rouse or set in

motion). Chemical secretions that act as signals for another individual of the same **species.**

Phylogenetic homology. See **homology.**

Phylogenetic hypothesis. See **phylogeny.**

Phylogeny [fī-lŏj'ə-nē] (Gr., *phylon* = race + *genesis* = birth or descent). A hypothesis of **evolutionary** relationships among the members of a **monophyletic group.** A phylogeny may be fully resolved (normally containing only dichotomous branching) or remain partly unresolved (containing polychotomous branch points or nodes). Also often referred to as an **evolutionary** tree.

Physoclistous [fī'sō-klī'stəs] (Gr., *physa* = bladder + *kleien* = to close). Pertaining to **fishes** in which the **swim bladder** is not connected to the digestive tract.

Physostomous [fī'sō-stō'məs] (Gr., *stoma* = mouth). Pertaining to the **fishes** in which the **swim bladder** remains connected to the digestive tract by a **pneumatic duct.**

Pia mater [pī'ə mā'tər] (L., = tender mother). The delicate vascular membrane that invests the **brain** and **spinal cord;** the innermost of the three **mammalian meninges.**

Pineal eye [pĭn'ē-əl] (L., *pineus* = relating to pine; from *pinus* = pine tree). A dorsal outgrowth of the **diencephalon** that forms a light-sensitive eye in some **fishes** and **amphibians** and becomes the **pineal gland** in **mammals.**

Pineal gland. An **endocrine gland** that produces **melatonin,** especially in the dark. **Melatonin** is believed to adjust many endogenous physiological processes to diurnal and seasonal cycles.

Pisces [pī'sēz] (Gr., = fishes). A **nonmonophyletic group** name of convenience for all **vertebrates** excluding **tetrapods** (i.e., **fishes**). See **monophyletic group.**

Pitch. The vertical rotation of a swimming or flying **vertebrate** about its longitudinal **axis.**

Pituitary gland [pĭ-tu'ĭ-tĕr'ē]. See **hypophysis.**

Placenta [plə-sĕn'tə] (L., = flat cake). The apposition or union of parts of the **uterine** lining and fetal extraembryonic membranes through which exchanges between mother and **embryo** occur.

Placental mammals. See **eutherians.**

Placode [plăk'ōd] (Gr., *placodes* from *plax* = plate + *eidos* = like). A thickened disk of **ectoderm** that gives rise to certain **sense organs** and **nerves. Neurogenic placodes** give rise to some receptor cells and sensory **neurons** in the head.

†Placoderms [plăk'ō-dûrmz] (Gr., *derma* = skin). A group of **Paleozoic** jawed **fishes** characterized by the extensive development of **bone** in the head and **thorax.**

Placoid scale. See **dermal denticle.**

Plantigrade [plăn'tĭ-grād] (L., *planta* = sole of the foot + *gradus* = step). Walking with the sole of the foot on the ground.

Plastron [plăs'trən] (French, = breastplate). The ventral shell of a turtle.

Plesiomorphic character [plē'sē-ō-môr'fĭk] (Gr., *plesios* = near + *morphe* = shape). A primitive or ancestral **character.** Meaningful only in a relative sense (e.g., the presence of **mammary glands** is primitive when considering only apes, but it is derived and **apomorphic** when considering all of **Mammalia**).

Pleura [pl'r'ə] (Gr., = side, rib). The **coelomic epithelium** in the **pleural cavities.**

Pleural cavities. The **coelomic** spaces that enclose the lungs of **mammals.**

Pleurapophysis [pl'r'ə-pŏf'ĭ-sĭs] (Gr., *apo* = away + *physis* = growth). A **vertebral** transverse process that incorporates a rib.

Pleurocentrum pl. **Pleurocentral** [pl'r'ō-sĕn'trəm] (L., *centrum* = center). A dorsolateral element of the **vertebral** body of **vertebrates** that becomes the main **vertebral** body of **amniotes.**

Pleurodont tooth [pl'r'ō-dŏnt] (Gr., *odont-* = tooth). A tooth that is loosely attached to the outside edge of the jaw.

Pleuroperitoneal cavity [pl'r'ō-pĕr'ĭ-tən-

ē'əl]. The **peritoneal cavity** and potential **pleural cavities** of **anamniotes** and some **reptiles;** contains the **viscera** and **lungs** (if present).

Plexus [plĕk'səs] (L., = a braid). A network of nerves or **blood** vessels.

Pneumatic duct [nu-măt'ĭk] (Gr., *pneuma* = air). The **duct** that connects the **swim bladder** with the **pharynx** in **physostomous fishes.**

Poikilothermic [poi'kĭ-lō-thûr'mĭk] (Gr., *poikilos* = varied + *thermos* = heat). Pertains to **vertebrates** in which the body temperature varies with the ambient temperature; **ectothermic.**

Pollex [pŏl'ĕks] (Gr., = thumb). The thumb.

Polyphyletic. See **nonmonophyletic group.**

Polyphyodont [pŏl'ē-fī'ō-dŏnt] (Gr., *polyphyes* = manifold + *odont-* = tooth). Pertaining to many successive sets of teeth.

Pons [pŏnz] (L., = bridge). The ventral part of the **metencephalon** of birds and **mammals;** has a conspicuous, superficial band of transverse fibers.

Portal veins [pôr'təl] (L., *porta* = gate). **Veins** that drain one **capillary** bed and lead to another one in a different organ, such as the **hepatic portal** and **hypophyseal** portal systems.

Posterior chamber. The cavity within the eyeball located between the **iris** and the **ciliary body.**

Postganglionic fiber [pōst'găng-glē-ŏn'ĭk] (Gr., *ganglion* = small tumor). A **neuron** of the **autonomic nervous system** with its cell body in a peripheral **ganglion** and its **axon** extending to the **effector** organ.

Posttrematic [pōst'trē-măt'ĭk] (Gr., *trema* = hole). Pertaining to **blood** vessels or **nerves** that lie **caudal** to a **branchial** pouch.

Power. The rate of doing **work.**

Preadaptation. The evolution of a feature that enables an animal to exploit a new environment, such as the **evolution** of **lungs** in certain **fishes.**

Preganglionic fibers [prē'găng-glē-ŏn'ĭk] (Gr., *ganglion* = small tumor). A **neuron** of the **autonomic nervous system** with its cell body in the **brain** or **spinal cord** and its **axon** extending to a peripheral **ganglion.**

Premolars [prē-mō'lərz] (L., *molaris* = millstone). **Cheek teeth** that lie rostral to the **molars** and may be specialized for cutting or grinding.

Pressure. Force per unit area, such as grams per square centimeter.

Pretrematic [prē'trē-măt'ĭk] (Gr., *trema* = hole). Pertain- ing to **blood** vessels or **nerves** that lie rostral to a **branchial** pouch.

Primates [prī'māts] (L., *primus* = one of the first). The **eutherian** group that includes lemurs, monkeys, apes, and humans.

Primitive character. A **character** state that is the ancestral condition for a group; also called a **plesiomorphic character.** For example, the presence of bone is primitive for birds, but, conversely, the presence of **feathers** is derived for birds. See **character, derived character.**

Primitive streak. A longitudinal thickening of cells on the **blastoderm** of large-yolked eggs, through which prospective **chordamesoderm** and **mesoderm** cells move inward; **homologous** to the **blastopore.**

Primordium [prī-môr'dē-əm] (L., = beginning). The first indication of the formation of a structure in an **embryo.**

Processus vaginalis [prō-sĕs'əs vă'jĭ'năl'ĭs] (L., = process + *vagina* = sheath). A sac that contains the **mammalian testis** and its sperm **duct** and **blood** vessels, as well as the **coelomic vaginal** cavity; located in the **scrotum,** also called **vaginal** sac.

Procoelous [prō-sē'ləs] (Gr., *koilios* = hollow). A **vertebral body** with a concavity on its cranial surface.

Proctodaeum [prŏk'tō-dē'əm] (Gr., *proktos* = anus + *hodaion* = way). An **ectodermal invagination** near the **caudal** end of the **embryo** that contributes to the **cloaca.**

Progenesis [prō-jĕn'ĭ-sĭs] (Gr., *pro* = before +

genesis = origin). **Paedomorphosis** that, in theory, results from the acceleration of reproductive maturity relative to **somatic** development.

Progesterone [prō-jĕs'tə-rōn] (L., *gesto,* pp. *gestatus* = to bear). A **hormone** produced by the **corpus luteum** and later by the **placenta;** prepares the **uterus** for the reception of a fertilized egg and maintains the **uterine** lining during pregnancy.

Prolactin [prō-lăk'tĭn] (L., *lac, lact-* = relating to milk). A **hormone** produced by the **adenohypophysis** that promotes maternal behavior and milk production.

Pronephros [prō-nĕf'rəs] (Gr., *pro* = before + *nephros* = kidney). The first formed **kidney** of a **vertebrate embryo,** which lies dorsal to the **pericardial cavity** and forms the **archinephric duct** before it **atrophies.**

Proprioceptor [prō'prē-ō-sĕp'tər] (L., *proprius* = one's own + *capio,* pp. *ceptus* = to take). A receptor in **muscles, tendons,** and joints that monitors the activity of **muscles.**

Prosencephalon [prŏs'ĕn-sĕf'ə-lŏn] (Gr., *pro* = before + *enkephalos* = brain). The **embryonic forebrain,** which gives rise to the **telencephalon** and **diencephalon.**

Prostate [prŏs'tāt] (Gr., *prostates* = one who stands before). An accessary sex **gland** of male **mammals** that surrounds the **urethra** just before the **urinary bladder.**

Protandry [prō-tăn'drē] (Gr., *protos* = first + *andr-* = man). Sequential **hermaphroditism** in which the **gonad** functions first as a **testis** before it acts as an **ovary.**

Protochordates [prō'tō-kôr'dāts] (L., *chorda* = string, cord). A **nonmonophyletic group** of convenience for the noncraniate **chordates:** the **tunicates** and **cephalochodates.**

Protogyny [prō-tŏj'ə-nē] (Gr., *gyne* = woman). Sequential **hermaphroditism** in which the **gonad** functions first as an **ovary** before it acts as a **testis.** See **hermaphrodite.**

Protostomes [prō'tō-stōmz] (Gr., *stoma* = mouth). Thegroup of **coelomate** animals in which the **blastopore** forms or contributes to the mouth; includes mollusks, annelids, and arthropods.

Prototherians [prō'tō-thîr'ē-ənz] (Gr., *therion* = wild beast). A primitive or basal branch of **Mammalia (mammals);** includes the contemporary, egg-laying **monotremes.**

Protraction [prō-trăk'shən] (L., *pro* = before + *traho,* pp. *tractus* = to pull). Muscle action that moves the entire appendage of a quadruped forward.

Proventriculus [prō'vĕn-trĭk'ŭ-lŭs] (L., *ventriculus* = smallbelly). The anterior, glandular portion of the **stomach** of birds.

Pseudobranch [sŭ'dō-brăŋk] (Gr., *pseudes* = false + *branchia* = gills). A small first gill of some **fishes,** without a respiratory function.

†Pterosaur [tĕr'ə-sôr] (Gr., *pteryg-* = fin or wing + *sauros* = lizard). An extinct order of flying **reptiles.**

Pterygiophores [tə-rĭj'ē-ō-fôrz] (Gr., *phoros* = bearing). The supporting **cartilages** or **bones** of the **fin rays.** Also called radials or basals.

Pubis [pyŭ'bĭs] (L., *pubes* = genital hair). The cranioventral **bone** of the **pelvis** of **tetrapods.**

Pulmonary [pʊl'mə-nĕr'-ē] (L., *pulmo* = lung). Pertaining to the **lungs,** as the pulmonary **artery.**

Pupil [pyŭ'pəl] (L., *pupilla* = pupil). The central opening through the **iris** of the eye.

Pygostyle [pī'gō-stīl] (Gr., *pyge* = rump + *stylos* = pillar). The fused, **caudal vertebrae** of a bird, which support the tail **feathers.**

Pylorus [pī-lôr'əs] (Gr., *pyloros* = gatekeeper). The **caudal** end of the **stomach,** which contains a **sphincter muscle.**

Pyramidal system [pĭ-răm'ĭ-dəl] (Gr., *pyramis* = pyramid). The direct motor pathway in **mammals** from the **cerebrum** to the motor **nuclei** and columns.

R

Radius [rā'dē-əs] (L., = ray). A **bone** of the forearm of **tetrapods** that rotates around the **ulna;** located on the thumb side when the hand is supine.

Ramus [rā'məs] (L., = branch). A branch such as those of a spinal nerve.

Rathke's pouch (*Martin H. Rathke,* German anatomist, 1793–1860). A dorsal **evagination** of the **stomadaeum** that forms the **adenophypophysis.**

Ray-finned fishes. See **actinopterygians.**

Receptor [rē-sĕp-tər] (L., = receiver). A specialized cell or **neuron** ending that responds to a specific stimulus and initiates a **nerve** impulse.

Rectum [rĕk'təm] (L., *rectus* = straight). The terminal segment of the **intestine** that leads to the **anus.**

Reflex [rē'flĕks] (L., *reflecto,* pp. *reflexus* = to bend backward). An innate reaction in response to a peripheral stimulus.

Releasing hormones. Hormones produced by the **hypothalamus** that travel in the **hypophyseal** portal system and promote the release of specific adenohypophyseal **hormones.** In several cases, inhibiting **hormones** are also known.

Renal [rē'nəl] (L., *ren* = kidney). Pertaining to the **kidneys.**

Renal capsule. The dilated end of a **kidney** tubule that surrounds a knot of **capillaries.**

Renal portal system. A system of **veins** that drains the tail and hind legs of most nonmammalian **vertebrates** and leads to the peritubular **capillaries** of the **kidneys.**

Renal tubule. A **kidney** tubule or **nephron.**

Reptiles [rĕp'tīlz] (L., *reptilis* = creeping). A **nonmonophyletic group** name of convenience. This term has most often referred to a group of **amniotes** including turtles, lizards, snakes, and crocodiles (among living **vertebrates**). Phylogenetically based classifications recognize that crocodilians and dinosaurs are more closely related to birds than to lizards and snakes, and that the precise relationships of turtles are yet unclear.

Resultant of force. A **vector** that expresses the interaction between two or more **vectors.**

Rete cords [rē'tē] (L., *rete* = net). Minute cords in the **embryo** that interconnect the primary **sex cords** and the cranial mesonephric tubules; they contribute to the **sperm** passages in males and regress in females.

Rete mirabile [mĭ-rä'bĭ-lə] (L., = wonderful net). A network of small **arteries** or **capillaries,** such as those associated with the gas **gland** of the **swim bladder.**

Reticular formation [rĭ-tĭk'yə-lər] (L., *reticulum* = small net). A network of short **interneurons** in the **brainstem** that forms a primitive integrating system. In **mammals,** it also projects to the **cerebrum** and helps maintain the level of arousal.

Reticulate speciation. A process theory involving the origin of a new **species** through hybridization of two different **species.**

Retina [rĕt'-n-ə]. The innermost layer of the eyeball; con-tains pigment cells, photoreceptive cells, and **neurons.**

Retraction [rĭ-trăk'shən] (L., *retractio* = a drawing back). **Muscle** action that moves the entire appendage of a quadruped backward.

Retroperitoneal [rĕ'trō-pĕr-ĭ-tən-ē'əl] (L., *retro* = backward + Gr., *peritonaion* = to stretch over). Pertaining to structures, such as the **kidneys,** that lie dorsal to the **peritoneal cavity.**

Rhinal [rī'nəl] (Gr., *rhin-* = nose). Pertaining to the nose.

Rhipidistians [rĭ'pĭ-dĭs'tē-ənz] (Gr., *rhipis* = fan). Often used as **nonmonophyletic group** name of convenience for certain **sarcopterygian fishes,** including the presumed ancestors of **tetrapods.** We use it here in a **monophyletic** sense. See **sarcopterygians.**

Rhombencephalon [rŏm'bĕn-sĕf'ə-lŏn] (Gr., *rhombos* = lozenge-shaped + *enkephalos* = brain). The hindbrain, the most posterior of the three primary divisions of the developing **brain;** subdivides into the **metencephalon** and **myelencephalon.**

Roll. Rotation of a swimming or flying **vertebrate** around its longitudinal **axis.**

Round window. See **fenestra cochleae.**

Rudiment [ru'dĭ-mənt] (L., *rudimentum* = first attempt). An early stage in the development of an organ; a **primordium.**

Rumen [r''mən] (L., *rumen* = gullet). The first and largest chamber of the **ruminant stomach.**

Ruminants [r''mĭ-nənts] (L., *rumino* = to chew the cud). Those **artiodactyls** with chambered **stomachs,** including deer, sheep, and cattle.

S

Sacculus [săk'yŭ-ləs] (L., = small sac). The most ventral chamber of the **membranous labyrinth.**

Sacral. Pertaining to the **sacrum.**

Sacrum [sā'krəl, sā'krəm] (L., *sacrum* = sacred). The **vertebrae,** or the union of two or more **vertebrae** and their ribs, by which the **pelvis articulates** with the **vertebral** column.

Salientia. See **anurans.**

Salivary gland [săl'ĭ-vĕr'ē] (L., *saliva* = saliva). A **gland** that produces the saliva; the major ones in **mammals** are the **parotid, mandibular,** and sublingual glands.

Salt gland. A **gland** or secretory cells that secrete excess salt; found near the nose and eye in certain marine **reptiles** and birds and on the **gill** of certain marine **fishes.**

Saltatorial [săl'tə-tôr'e-əl] (L., *saltatio* = to dance). Adapted for leaping.

Sarcopterygians [sär'kŏp-tə-rĭj'ē-ənz] (Gr., *sarkodes* = fleshy + *pteryg-* = fin or wing). The group of **Osteichthyes** with fleshy ("lobed"), paired **fins,** including **coelacanths, rhipidistians,** lungfishes, and **tetrapods.** Traditionally, this group included only **fishes** (i.e., excluded **tetrapods**), but sarcopterygians are more closely related to **tetrapods** than they are to **ray-finned fishes** or sharks.

Sauropsida. A group (as used here) containing **reptiles** and birds.

Scala tympani [skā'lə tĭm'pă-nē] (L., *scala* = ladder + *tympanum* = drum). The **perilymphatic duct** through which pressure waves pass from the **cochlea** to the **tympanic cavity.**

Scala vestibuli [vĕs-tĭb'yŭ-lē] (L., *vestibulum* = antechamber). The **perilymphatic duct** through which pressure waves enter the **cochlea** from the **auditory ossicle.**

Scales. Hard, platelike structures on the surface of the skin in many vertebrates.

Scaling. Analyzing the relationship between the size of a structure, or level of activity of a process, and body size.

Scapula [skăp'yŭ-lə] (L., = shoulder blade). The dorsal element of the **pectoral girdle** that ossifies from **cartilage.**

Schizocoele [skĭz'ə-sēl] (Gr., *schizo* = to cleave + *koilos* = hollow). A **coelom** formed by cavitation of the **mesoderm** rather than by **enterocoelic** pouches, characteristic of **protostomes.**

Schwann cells (*Theodor Schwann,* German histologist, 1810–1882). See **neurilema.**

Sclera [sklîr'ə] (Gr., *skleros* = hard). The opaque, "white" portion of the **fibrous tunic** of the eyeball.

Sclerotic bones [sklə-rŏt'ĭk] (Gr., *oto-* = ear). A ring of **bones** that develops in the **sclera** of some **vertebrates** and strengthens the eyeball wall.

Sclerotome [sklîr'ə-tōm] (Gr., *tomos* = a cutting). The medial portion of a **somite** that forms the **vertebrae** and the **caudal** part of the **chondrocranium.**

Scrotum [skrō'təm] (L., = pouch). The sac that encases the **mammalian testes;** it includes all of

the layers of the body wall.

Sebaceous glands [sĭ-bā'shē-ŭs] (L., *sebum* = tallow). **Mammalian cutaneous glands** that secrete oily and waxy materials.

Secondary palate. A **palate** that separates the food and air passages; in **mammals,** it consists of a **bony hard palate** that separates the **oral** and **nasal cavities** and a fleshy **soft palate** that separates the **oral pharynx** from the **nasal pharynx.**

Secretin [sĭ-krēt'ĭn] (L., *secerno,* pp. *secretus* = to secrete). A **hormone** produced by the **duodenal mucosa** that promotes the secretion of the aqueous portion of the **pancreatic** juice.

Segmentation [sĕg'mən-tā'shən]. Refers to the division of the body into a longitudinal series of segments.

Selachian [sĭ-lā'kē-ən] (Gr., *selachios* = resembling a shark). A **taxonomic** subdivision of sharks.

Selenodont [sĭ-lē'nō-dŏnt] (Gr., *selene* = crescent + *odont-* = tooth). **Mammalian cheek teeth** with crescent-shaped cusps.

Semicircular duct [sĕm'ĭ-sûr'kyə-lər]. One of the **ducts,** shaped like a half-circle, of the **membranous labyrinth;** semicircular ducts are located within a set of semicircular canals in the **otic capsule** of the **skull.**

Seminal fluid [sĕm'ə-nəl] (L., *semen* = seed). The fluid secreted by male reproductive **ducts** and accessory sex **glands** that carries the **sperm.**

Seminal vesicle. See **vesicular gland.**

Seminiferous tubules [sĕm'ə-nĭf'ər-əs]. The tubules within the **testis** that produce the **sperm.**

Sense organ. An aggregation of receptive cells and associated cells that support them and may amplify a stimulus.

Septum. A partition between two structures. Also, a group of small nuclei within the rostral ventromedial wall of the **subpallium.**

Serial homology. A type of **homology** referring to similarity between different parts of a series of structures within a single organism (e.g., different leaves on a branch, different segments of a worm, different limbs of a **tetrapod**). See **homology.**

Sertoli cells (*Enrico Sertoli,* Italian histologist, 1842–1910). **Epithelial** cells of the **seminiferous tubules** that play a role in the maturation of the **sperm.**

Sesamoid bone [sĕs'ə-moid] (Gr., *sesamon* = sesame seed + *eidos* = form). A **bone** that develops in the **tendon** of a **muscle** near its insertion and facilitates the movement of a **muscle** across a joint, acts as a **lever** arm, or alters its direction of pull; the **patella** and pisiform are examples.

Sessile [sĕs'əl] (L., *sessilus* = fit for sitting). Describes an animal that lives attached to its substratum.

Sex cords. Embronic cords of **epithelium** and **primordial** germ cells that give rise to the **seminiferous tubules** or **ovarian follicles.**

Sexual homology. Parts in different sexes of the same **species** that develop from the same type of **primordium.**

Shear. A **stress** that results from two parallel but not directly opposite **forces** that are moving toward each other.

Sinus [sī'nŭs] (L., = a cavity). A cavity or space within an organ.

Sinusoids [sī'nə-soidz] (Gr., *eidos* = form). **Capillary**-sized **blood** spaces in the **liver** or other organs that are not completely lined by **endothelial** cells.

Sinus venosus [vē-nō'səs]. The most **caudal** chamber of the **heart** of **anamniotes** and some **reptiles;** receives the systemic **veins.**

Sister group. The closest **monophyletic group** outside the **ingroup.** See **ingroup, outgroup, monophyletic group.**

Skin. See **integument.**

Skull [skŭl] (Old English, *skulle* = bowl). The group of **bones** and **cartilages** that encase the **brain** and major **sense organs** and form the jaws; the lower jaw sometimes is not considered to be a part of the **skull.**

Soaring. A type of flight in which the wings are held stationary and the animal remains aloft by utilizing upward air currents (static soaring) or differential air speeds at different elevations (dynamic soaring).

Soft palate. A fleshy **palate** in **mammals** that separates the **nasal** and **oral pharynx;** part of the **secondary palate.**

Somatic [sō-măt'ĭk] (Gr., *somatikos* = bodily). Refers to structures that develop in the body wall or appendages as opposed to those in the gut tube, such as the somatic **muscles,** somatic skeleton.

Somite [sō'mīt]. One of the series of dorsal segments, or divisions of the **paraxial mesoderm,** in the trunk and **caudal** part of the head in a developing **embryo;** also called an epimere.

Somitomere [sō'mə-tō-mîr] (Gr., *meros* = part). One of the partial divisions of the **paraxial mesoderm** in the rostral part of the head of a developing **embryo.**

Specialization. Presumed **adaptations** to a particular habitat and mode of life.

Speciation. The process leading to the origin of new **species** through time. See **anagenesis, cladogenesis, reticulate speciation.**

Species [spē'shēz] (L., = particular kind). Several different definitions of the term "species" exist, some of which conflict. In general, most of these definitions specify reproductive coherence due to genetic and behavioral compatibility of the sexes (in the case of sexually reproducing organisms), uniqueness of **evolutionary** role (due to genetic isolation from other species), an origin (time of speciation), and an end (extinction or **cladogenesis,** either past or predicted for the future). Some systematists believe the species are neither more nor less real than higher **taxa** and that they should be defined as the smallest discernible **monophyletic group.** See **cladogenesis, monophyletic group, speciation.**

Sperm (Gr., *sperma* = seed). The mature male **gametes,** also called spermatozoa.

Spermatogenesis [spûr-măt'ō-jĕn'ĭ-sĭs] (Gr., *genesis* = birth, descent). The formation and maturation of the **sperm.**

Spermatophore [spûr-măt'ō-fôr] (Gr., *phoros* = bearing). A clump of **sperm** encapsulated in mucoid material; deposited by some male salamanders.

Sphincter [sfĭngk'tər] (Gr., *sphinkter* = band, lace). A circular **muscle** that closes the opening of an organ or surrounds another structure, e.g., the pyloric sphincter, sphincter colli muscle.

Spinal column [spī'nəl] (L., *spina* = thorn, backbone). The **vertebral** column.

Spinal cord. The **central nervous system caudal** to the **brain.**

Spiracle [spîr'ə-kəl] (L., *spiraculum* = air hole). The reduced first **gill** pouch of some **fishes** through which water may enter the **pharynx;** also, the opening from the **gill** chamber of frog tadpoles.

Spiral valve (L., *spira* = coil). A helical coil in the **intestine** of early **fishes;** also a fold within the **conus arteriosus** and **ventral aorta** of lungfishes and some **amphibians** and **reptiles** that helps separate pulmonary and systemic bloodstreams.

Splanchnic [splăngk'nĭk] (Gr., *splanchnon* = gut, viscus). Descriptive of structures that supply the gut, such as the splanchnic **nerves.**

Splanchnocranium [splăngk'nō-krā'nē-əm] (Gr., *kranion* = skull). The portion of the cranial skeleton composed of the **visceral arches.**

Spleen [splēn] (Gr., *splen* = spleen). A vascular organ near the **stomach** in which **blood** cells may be produced, stored, and eliminated.

Squamates [skwā'mātz] (L., *squama* = scale). The **reptilian** division that includes the lizards, amphisbaenians, and snakes.

Stall. Sudden loss of lift by the wings.

Stapes [stā'pēz] (L., = stirrup). The most medi-

al of the three **auditory ossicles** of **mammals; homologous** to the **hyomandibula** of **fishes** and **columella** of nonmammalian **tetrapods.**

Step. The distance a **tetrapod** moves forward by the action of one leg and foot.

Sternum [stûr'nəm] (Gr., *sternon* = chest). The breastbone of **tetrapods.**

Stomach [stûm'ək] (Gr., *stomacos* = stomach). The part of the digestive tract where food is stored temporarily and where digestion usually is initiated.

Stomodaeum [stō'mə-dē'əm] (Gr., *stoma* = mouth + *hodaion* = on the way). An **ectodermal invagination** at the front of the **embryo** that forms the **oral cavity.**

Strain. The deformation in a material that results from **stress.**

Stratum [străt'əm] (L., = layer). A layer of **tissue,** such as the stratum corneum on the **skin** surface.

Stress. The **force** per unit area that is applied to a material.

Striatum [strī-ā'tŭm] (L., *striatus* = striped). A group of **nuclei** in the base of the **cerebrum** through which white fibers pass; part of the **subpallium.**

Stride. The distance a **tetrapod** moves forward from the placement of one foot on the ground to the next placement of the same foot; equivalent to four **steps** in a quadruped.

Subpallium [sŭb-păl'ē-əm] (L., *sub* = under + *pallium* = cloak). **Gray matter** of the **cerebrum** lying ventral to the **pallium;** includes the **striatum** and **septum**.

Sulcus [sŭl'kəs] (L., = groove). A groove on the surface of an organ, such as the sulci on the **cerebrum** of a **mammal.**

Sulcus limitans [lĭm'ĭ-tənz]. A groove in the central canal of the nervous system that delineates the dorsal sensory areas of **gray matter** from the ventral motor ones.

Summation [sŭm-ā'shən]. The addition of successive events that come in rapid sequence to produce a response, or a response of greater magnitude.

Suprarenal gland. See **adrenal gland.**

Suprasegmental control. A level of integration by parts of the **brain** that is superimposed on the basic pattern of activity of lower centers.

Surfactant [sûr-făk'tənt] (L., *superficius* = superficial + *actio,* pp. *actus* = to do). A surface tension depressant found on the lining of the **lungs.**

Suture [sŭ'chər] (L., = seam). An immovable joint (and type of **synarthrosis**) in which the **bones** are separated by a septum of **connective tissue,** such as those between **dermal bones** of the **skull.**

Sweat glands. Mammalian cutaneous glands that secrete a watery solution (eccrine sweat glands) or odoriferous materials (apocrine sweat glands).

Swim bladder. A sac of gas, located dorsally in the body cavity of most **actinopterygians,** that has a hydrostatic function.

Sympathetic nervous system [sĭm'pə-thĕt'ĭk] (Gr., *sym* = with + *pathos* = feeling). The part of the **autonomic nervous system** that, in **mammals,** leaves the **central nervous system** from parts of the **spinal cord;** its activity helps an animal adjust to stress by promoting physiological processes that increase the energy available to **tissues.**

Symphysis [sĭm'fĭ-sĭs] (Gr., *physis* = growth). A joint (and type of **synarthrosis**) between bones that permits limited movement by the deformation of the **fibrocartilage** between them, as the **pelvic** symphysis; usually occurs in the midline of the body.

Synapomorphy. A shared derived **character** or **character** state at its most **taxonomically** inclusive level. A **character diagnosing** a **monophyletic group** (e.g., the presence of jaws for Gnathostomata). See **apomorphy, character.**

Equivalent to a **phylogenetic homology.** See **homology.**

Synapse [sĭn'ăps] (Gr., *synapsis* = union). The junction at which an impulse passes from one **neuron** to another.

Synapsid [sĭ-năp'sĭd] (Gr., *apsid* = loop or bar). A **skull** with a single laterally placed temporal **fenestra,** or a group of **vertebrates** with such a **skull,** such as the **Synapsida.**

Synapsida. A group containing **Mammalia** plus a number of closely related extinct lineages or **taxa.**

Synarthrosis [sĭn'ăr-thrō'sĭs] (Gr., *arthron* = joint). A joint with fibrous or **cartilaginous** material between the adjacent elements; growth can occur here but no or only limited movement.

Synchondrosis [sĭn'kŏn-drō'sĭs] (Gr., *chondros* = cartilage). A joint (or type of **synarthrosis**) in which **cartilage** separates two **bony** elements, found between **bones** that ossify in the **chondrocranium;** growth can occur but only limited movement.

Synergy [sĭn'ər-jē] (Gr., *ergon* = work). Pertaining to different **muscles** or other organs that interact to produce a common effect.

Synovial fluid [sĭ-nō'vē-əl] (L., *synovia* = joint oil). A clear fluid that serves as a lubricant in movable joints.

Synovial joint. See **diarthrosis.**

Synsacrum [sĭn-sā'krəm] (L., *sacrum* = sacred). The group of fused **vertebrae** and their ribs in birds that **articulates** with the **pelvis.**

Syrinx [sîr'ĭngks] (Gr., = panpipe). The voice box of birds, located at the distal end of the **trachea.**

Systemic circulation [sĭ-stĕm'ĭk] (Gr., *systema* = a whole composed of several parts). The circulation through the body as a whole, exclusive of the circulation through the respiratory organs (**branchial** or pulmonary circulation) or **heart** (coronary circulation).

Systole [sĭs'tə-lē] (Gr., = a drawing together). The period during which the **ventricle** of the **heart** contracts and expels blood.

T

Tapetum lucidum [tə-pē'təm lŭ'sĭd-əm] (L., *tapete* = carpet + *lucidus* = clear, shining). A layer within or behind the **retina** of some **vertebrates** that reflects light back onto the photoreceptive cells.

Tarsal [tär'səl] (Gr., *tarsos* = sole of the foot). One of the **bones** in the ankle.

Taxon [tăk'sŏn], pl. **taxa** (Gr., *taxis* = arrangement). A group of organisms given a proper name for the sake of classification. A taxon can be (and should be, in the authors' opinion) **monophyletic** (e.g., the **genus** *Clupea,* which includes the true herrings, or the family Acipenseridae, which includes the sturgeons). Occasionally taxon is also used to refer to **nonmonophyletic groups** such as the traditional **"Reptilia"** (a group that excludes some of its putative descendants, i.e., birds). Taxa are defined through **characters** that are discovered through empirical investigation. See **character, Linnean classification system, monophyletic group.**

Taxonomic group. See **taxon.** (Taxonomic group = a taxon.)

Tectum [tĕk'təm] (L., = roof). A roof, specifically the roof of the **mesencephalon.**

Tegmentum [tĕg-mĕn'təm] (L., *tegmen* = covering). The floor of the **mesencephalon** or **metencephalon.**

Telachoroidea [tē'lə-kə-roi'dē-ə] (L., *tela* = web + Gr., *chorion* = membrane enclosing the fetus + *eidos* = form). A thin membrane composed of the **ependymal epithelium** and the vascular **meninx** that forms the roof or wall of some **ventricles.**

Telencephalon [tĕl'ĕn-sĕf'ə-lŏn] (Gr., *telos* = end + *enkephalos* = brain). The rostral part of the **forebrain** from which the **olfactory bulbs** and **cerebral hemispheres** develop.

Teleosts [tē'lē-ôsts] (Gr., *osteon* = bone). An extremely speciose group of **vertebrates** including all living **neopterygian fishes** other than gars and bowfins.

Telodendria [têl'ō-dĕn'drē-ə] (Gr., *dendria* = trees). The terminal branches of an **axon.** See **terminal arborization.**

Tendon [tĕn'dən] (L., *tendo* = to stretch). A cord of dense **connective tissue** that extends between a **muscle** and its attachment.

Tendon organ. A **proprioceptor** in **tendons** that is stimulated by **tension** developed by **muscle** contraction.

Tension. The **stress** that results from two parallel **forces** pulling directly away from each other.

Tentorium [tĕn-tôr'ē-əm] (L., = tent). The septum of **dura mater,** ossified in some **species,** that extends between the **cerebrum** and **cerebellum.**

Terminal arborization. The terminal branching of a **neuron**.

Terminal nerve. A small **nerve** present beside the **olfactory nerve** in most **vertebrates;** its function is unclear, but it may have a role in detecting **pheromones** and regulating reproductive functions.

Testis [tĕs'tĭs] (L., = witness, originally an adult male, testis). The male reproductive organ, which produces **sperm** and male sex **hormones.**

Testosterone [tĕs-tŏs'tə-rōn]. The male sex **hormone** produced by the **testis;** promotes the development of male secondary sex characteristics and of **sperm.**

Tetrapods [tĕt'rə-pŏdz] (Gr., *tetra* = four + *pous, podos* = foot). A common name for terrestrial **vertebrates;** they have four feet unless some have been secondarily lost or converted to other uses.

Thalamus [thăl'ə-məs] (Gr., *thalamos* = chamber, bedroom). The lateral walls of the **diencephalon;** an important center between the **cerebrum** and other parts of the **brain.**

Thecodont teeth [thē'kō-dŏnt] (Gr., *theke* = case + *odous, odont-* = tooth). Teeth that are set in sockets.

Therapsid [thə-răp'sĭd] (Gr., *therion* = wild beast + *apsis* = arch). A group of **synapsids** very closely related to **mammals.**

Therians [thîr'ē-ənz]. The group of **mammals** that includes the **marsupials** and **eutherians.**

Thoracic duct [thə-răs'ĭk] (Gr., *thorax* = chest). The large lymphatic **duct** of **mammals** that passes through the **thorax** and enters the large **veins** near the **heart.**

Thorax [thôr'ăks]. The region of the **mammalian** body encased by the ribs.

Thymus [thī'məs] (Gr., *thymos* = thyme, thymus; so called because it resembles a bunch of thyme). The lymphoid organ that develops from certain pharyngeal pouches, necessary as the site where certain T lymphocytes mature.

Thyroid gland [thī'roid] (Gr., *thyroides* = resembling an oblong shield). An **endocrine gland** that develops from the floor of the **pharynx** and in humans is located adjacent to the thyroid **cartilage** of the **larynx;** its **hormones** increase the rate of metabolism.

Thyroid-stimulating hormone. A **hormone** produced by the **adenohypophysis** that promotes the secretion of the **thyroid gland.**

Thyroxine [thī-rŏk'sēn] (Gr., *oxo-* = oxygen). One of the **hormones** released by the **thyroid gland.**

Tibia [tĭb'ē-ə] (L., = the large shinbone). The **bone** on the medial side of the lower leg, in line with the first **digit.**

Tissue [tĭsh'ŭ] (Old French, *tissu* = woven). An aggregation of cells that together perform a similar function.

Tongue [tŭng] (Old English, *tunge*). A **muscular** mobile organ on the floor of the **oral cavity** of **tetrapods** that often helps gather food and manipulates it within the mouth.

Tonsil [tŏn'səl] (L., *tonsilla* = tonsil). One of the lymphoid organs that develops in the wall of the **pharynx** near the level of the second pharyngeal pouch.

Torque. A turning **force** equal to the product of the **force** and the perpendicular distance between the line of action of the **force** and the **fulcrum** about which it acts; also called a **moment.**

Trabeculae [trə-bĕk'yŭ-lē] (L., = little beams). Small, rod-like skeletal structures, such as the trabeculae within **bones.**

Trachea [trā'kē-ə] (L., *tracheia arteria* = rough artery, windpipe). The respiratory tube between the **larynx** and the **bronchi.**

Tract [trăkt] (L., *tractus* = a drawing out). A group of **axons** of similar function traveling together in the **central nervous system.**

Transverse septum. The partition of **epithelium** that separates the pericardial from the **pleuroperitoneal cavity.**

Trigeminal nerve [trī-jĕm'ə-nəl] (L., *trigeminus* = threefold). The fifth cranial nerve, which has three branches in **mammals;** it innervates the **muscles** of the **mandibular arch** and returns sensory fibers from **cutaneous receptors** over most of the head.

Triiodothyronine [trī-ī'ō-dō-thī'rə-nēn] (Gr., *tri* = three + *iodo* = violet-like or iodine + *thyroides* = resembling an oblong shield). A **hormone** produced by the **thyroid gland.**

Trochanter [trō-kăn'tər] (Gr., = a runner). One of the processes on the proximal end of the **femur** to which thigh **muscles** attach.

Trochlear nerve [trŏk'lē-ər] (L., *trochlea* = pulley). The fourth cranial **nerve,** which innervates the superior oblique **muscle;** the **mammalian muscle** passes through a **connective tissue** pulley before inserting on the eyeball.

Trophoblast [trō'fō-blăst] (Gr., *trophe* = nourishment + *blastos* = bud). The outer layer of the **mammalian blastocyst;** initiates **placenta** formation; **homologous** to the **chorionic ectoderm.**

Tunic [tŭ'nĭk] (L., *tunica* = coating). Describes a layer of an organ, such as the layers of the eyeball.

Tunicates [tŭ'nĭ-kĭts]. The group of **chordates** that includes the sea squirts and their allies; also called urochordates.

Turbinate bones [tûr'bə-nāt] (L., *turbinatus* = top-shaped, whirlwind). Scroll-shaped **bones** in the **nasal** cavities of **mammals** that increase the surface area of the cavities; also called **conchae.**

Turbulent flow. A disrupted flow of fluid along the surface of a swimming or flying **vertebrate.**

Tympanic cavity (L., *tympanum* = drum). The **middle ear** cavity, which lies between the **tympanic membrane** and the **otic capsule** containing the **inner ear.**

Tympanic membrane. The eardrum.

U

Ulna [ŭl'nə] (L., = elbow). The bone of the **antebrachium** of **tetrapods** that extends behind the elbow, lying on the side adjacent to the fifth finger when the hand is supine.

Ultimobranchial bodies [ŭl'tə-mō-brăng'kē-əl] (L., *ultimus* = farthest + Gr. *branchia* = gills). Derivatives of the **caudal** surface of the last **branchial** pouch; in **fishes,** they contain the C cells, the **hormone** of which, calcitonin, helps regulate mineral metabolism.

Ungulates [ŭng'gyə-lĭts] (L., *ungula* = hoof). A collective term for the hoofed **mammals: artiodactyls** and **perissodactyls.**

Unguligrade [ŭng'gyə-lĭ-grād] (L., *gradus* = step). Walking on the toe tips.

Urea [y'-rē'ə] (Gr., *ouron* = urine). A breakdown product of nitrogen metabolism; occurs in **elasmobranchs,** some **amphibians,** and **mammals.**

Ureter [y'-rē'tər] (Gr., *oureter* = ureter, from *ouron* = urine). The **duct** of **amniotes** that carries **urine** from a **metanephric kidney** to the **urinary bladder.**

Urethra [y'-rē'thrə] (Gr., *ourethra* = urethra). The **duct** in **amniotes** that carries urine from the **urinary bladder** to the **cloaca** or outside; part of it also carries **sperm** in males.

Uric acid [y'r'ĭk] (Gr., *ouron* = urine). A break-

down product of nitrogen metabolism; occurs chiefly in **reptiles** and birds, requires that little water be removed from the body.

Urinary bladder [y'r'ə-nĕr-ē]. A saccular organ in which urine accumulates before discharge from the body.

Urodeles [y'r'ō-dēlz] (Gr., *oura* = tail + *delos* = visible). The **amphibian** subgroup that includes the salamanders; also called **Caudata.**

Urogenital [y'r'ō-jĕn'ĭ-tl] (Gr., *ouron* = urine + L., *genitalis* = genital). Pertains to structures that are common to the urinary and genital systems, such as certain urogenital **ducts.**

Urophysis [y'r'ō-fĭ'sĭs] (Gr., *oura* = tail + *physis* = growth). A neurosecretory organ on the **caudal** end of the **spinal cord** in **elasmobranchs** and **teleosts.**

Uropygeal gland [y'r'ō-pī'jē-əl] (Gr., *pyge* = rump). An oil-secreting **gland** of birds, located dorsal to the tail base.

Urostyle [y'r'ō-stīl] (Gr., *stylos* = pillar). An elongated **bone** of **anurans** that represents fused **caudal vertebrae.**

Uterine tube [yŭ'tər-ĭn] (L., *uterus* = womb). The portion of the **mammalian oviduct** that carries eggs from the **coelom** to the **uterus;** also called the **fallopian tube;** site of fertilization.

Uterus [yŭ'tər-əs]. The portion of an **oviduct** in which **embryos** develop in live-bearing **species.**

Utriculus [yŭ-trĭk'yə-ləs] (L., = small sac). The upper chamber of the **membranous labyrinth** to which the **semicircular ducts** attach.

V

Vagina [və-jī'nə] (L., = sheath). The passage in female **therians** that leads from the **uterus** to the **vaginal vestibule.**

Vaginal vestibule [vĕs'tə-byul] (L., *vestibulum* = antechamber). The passage or space in female **therians** that receives the **vagina** and **urethra;** also called the **urogenital sinus.**

Vagus nerve [vā'gəs] (L., = wandering). The tenth cranial **nerve;** carries motor fibers to the **muscles** of the last four **visceral arches,** autonomic fibers to the **heart** and **viscera,** returns sensory fibers from these areas, and supplies the **lateral line canal** in **fishes** and **larval amphibians.**

Vas deferens [văs]. See **deferent duct.**

Vasa efferentia [vā'sə]. See **efferent ductules.**

Vascular tunic [văs'kyə-lər] (L., *vasculum* = small vessel). The middle layer of the eyeball; it forms the **choroid, ciliary body,** and **iris.**

Vasopressin. See **antidiuretic hormone.**

Vector [vĕk'tər] (L., *vector* = bearer). A quantity, such as a **force,** that has both a magnitude and a direction.

Vein [vān] (L., *vena* = vein). A vessel that conveys **blood** toward the **heart;** most veins contain blood low in oxygen content, but pulmonary veins from the **lungs** are rich in oxygen.

Velocity [və-lŏs'ĭ-tē]. Distance traveled divided by the time unit.

Vena cava [vē'nə cā'və] (L., = hollow vein). One of the major **veins** of lungfishes, **amphibians,** and **amniotes;** leads directly to the **heart.**

Ventral aorta [ā-ôr'tə]. An artery that leads from the **heart** to the **aortic arches** and their derivatives; contributes to the arch of the **aorta** and base of the **pulmonary artery** in **mammals.**

Ventricle [vĕn'trĭ-kəl] (L., *ventriculus* = small belly). The chamber of the **heart** that greatly increases **blood** pressure and sends **blood** to the **arteries;** also a chamber within the **brain.**

Vermis [vûr'mĭs] (L., = worm). The "segmented" medial portion of the **amniote cerebellum.**

Vertebra [vûr'tə-brə] (L., = joint, vertebra). One of the skeletal units that make up the spinal column.

Vertebral arch. The arch of a **vertebra** that surrounds the **spinal cord;** also called a **neural arch.**

Vertebral body. The main supporting component of a **vertebra,** lying ventral to the **vertebral arch;** also called the **centrum.**

Vertebrates [vûr'tə-brāts]. The subgroup of **craniates** that contains **species** with at least an incipient **vertebral** column; excluding hagfishes, all **craniates** are **vertebrates.**

Vesicular gland [vĕ-sĭk'ə-lər] (L., *vesicus* = small bladder). One of the accessory sex **glands** of males that contributes to the **seminal fluid.**

Vestibular apparatus [vĕ-stĭb'yə-lər] (L., *vestibulum* = entrance). The portion of the **inner ear** that detects changes in position and **acceleration.**

Vestibulocochlear nerve [vĕs-tĭb'yə-lō-kŏk'lē-ər] (L., *cochlea* = snail shell). The eighth cranial **nerve,** which returns fibers from the parts of the **inner ear** related to equilibrium and sound detection; often called the statoacoustic **nerve** in **anamniotes.**

Vestige [vĕs'tĭj] (L., *vestigium* = trace). A remnant in one organism of a structure that is well developed in another organism and has no function or a different function from that of its well-developed **homologue.**

Vestigial. See **vestige.**

Villi [vĭl'ī] (L., = shaggy hairs). Multicellular but minute, often finger-shaped projections of an organ that increase its surface area, such as the **intestinal** villi.

Viscera [vĭs'ər-ə] (L., = internal organs). A collective term for the internal organs.

Visceral arches. The skeletal arches that develop in the wall of the **pharynx;** include the **mandibular, hyoid,** and **brancial arches.**

Vitelline [vĭ-tĕl'ĭn] (L., *vitellus* = yolk). Pertains to structures associated with the **embryonic yolk sac,** such as the vitelline **arteries** and **veins.**

Vitreous body [vĭ'trē-əs] (L., *vitreus* = glassy). The clear, viscous material in the eyeball between the **lens** and **retina.**

Viviparity [vĭv'ə-pĕr'ĭ-tē] (L., *vivus* = living + *pario* = to bring forth). A pattern of reproduction in which the **embryos** are born as miniature adults. The term is often limited to **placental** viviparity, in which the **embryos** are completely dependent on materials transferred from the mother.

Vocal cords [vō'kəl] (L., *vocalis* = pertaining to the voice). Folds of mucous membrane within the **larynx** of many **tetrapods** the vibrations of which produce sound.

Vomeronasal organ [vō'mər-ō-nā'zəl]. An accessory **olfactory** organ located between the palate and **nasal** cavities of most **tetrapods,** important in feeding and sexual behavior. See also **Jacobson's organ.**

Vulva [vŭl'və] (L., = covering). The external genitalia of a female.

W

Weberian ossicles [ŏs'ĭ-kəlz] (*E. H. Weber,* German anatomist, 1u95–18u8 + L., *ossiculum* = small bone). A set of small **bones** that transmit sound waves from the **swim bladder** to the **inner ear** in some **teleosts.**

Weight. The mass of a structure times the acceleration of gravity.

White matter. Tissue in the **central nervous system** that consists primarily of myelinated **axons.**

Wing loading. The weight of a bird divided by the area of its wings.

Wolffian duct. (*K. F. Wolff,* 18th-century German embryologist). A term often applied to the **embryonic archinephric duct.**

Work. The product of a **force** and the distance through which it acts.

Y

Yaw. The tendency for the head of swimming or flying **vertebrates** to move from left to right about its longitudinal **axis.**

Yolk sac [yōk] (Anglo-Saxon, *geula* = yellow). The yolk-containing sac attached to the ventral surface of **embryos** that develops from

macrolecithal eggs.

Z

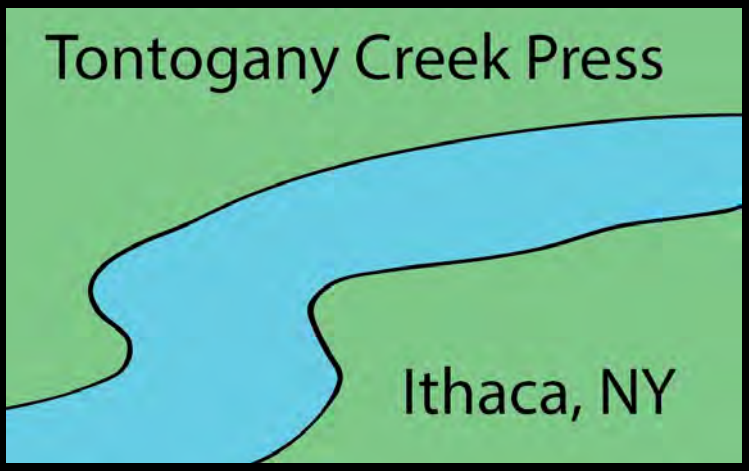
Zygapophysis [zī'gə-pŏf'ĭ-sĭs] (Gr., *zygon* = yoke + *apo* = away from + *physis* = growth). A process of a **vertebral arch** that articulates with a comparable process on an adjacent arch; also called **articular process.**

Zygomatic arch [zī'gō-măt'ĭk] (Gr., *zygoma* = bar, yoke). The arch of **bone** in a **mammalian skull** that lies beneath the **orbit** and connects the **facial** and cranial regions of the **skull.**

Zygote [zī'gōt] (Gr., *zygotes* = yoked together). The cell formed by the union of a **sperm** and an egg.

On the Cover:
Larval Ocean Sunfish, *Mola mola*, based on micro-CT scanning. Specimen is 7.4 mm long.

Filled with color illustrations and photographs, this book combines the study of vertebrate diversity with analyses of vertebrate anatomy and phylogenetic characters.



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Together, the authors have taught vertebrate biology for nearly 70 years, including 15 years jointly teaching the course on which this manual is based. They also collaborated to develop *Sharks*, a massive open online course on shark biology, available free to anyone in the world, through edX.com.