

GLOSSARY OF TERMS FOR ECHINODERMS

(taken from the SERTC Echinoderm Taxonomy Workshop manual)

ABACTINAL. The area of the body opposite the mouth.

ABORAL. In a direction away from the mouth; the part of the body opposite the mouth.

ACCESSORY DORSAL ARM PLATE. In some ophiuroids, one or several small, symmetrically arranged plates that are inserted between the dorsal arm plate and the lateral arm plate.

ACTINAL. The surface of the body that contains the mouth.

ADAMBULACRAL. Towards, or immediately adjacent to, an ambulacrum.

ADAPICAL. In echinoids, towards the highest part of the test.

ADORAL SHIELDS. In ophiuroids, a pair of plates, one of which is found at each side of the oral shield.

ADPRESSED. Squeezed against. The adpressed arm spines of ophiuroids are flattened against the sides of the arm.

AMBULACRAL GROOVE. In asteroids, the groove on the oral (ventral) surface of the arm, in which the tube feet are carried. Its sides are formed by the adambulacral plates, and it is roofed by the ambulacral plates. In crinoids, a furrow on the oral (dorsal) surface of the pinnules, arms, and central body, which is lined with cilia and bordered by the tube feet.

AMBULACRUM. A zone of the body that carries tube feet (pl. ambulacra).

Echinoderms generally have 5 ambulacra. The midline of an ambulacrum is a radius.

ANAL CONE (or TUBE). In crinoids and echinoids, a fleshy projection bearing the anus at its apex.

ANCHOR. See OSSICLE TYPES.

ANCHOR PLATE. See OSSICLE TYPES.

APICAL SYSTEM. In echinoids, a ring of specialized skeletal plates, including the genital plates and ocular plates. Usually located on the highest point of the test.

APODOUS (APODAN). Lacking tube feet, in reference to holothurians.

APPENDAGE. A tube foot, spine, pedicellaria, or arm of an adult, or a projection from the larval body. In holothuroids, the tube feet may be modified to form a papilla lacking terminal suckers.

ARM. In asteroids, crinoids and ophiuroids, a moveable, jointed ambulacral projection, distal to the disc or calyx, that carries a radial branch of the water vascular system and the nervous system. Sometimes called a ray.

ARM JOINT. In ophiuroids, one of a series of articulating units comprising the arm, consisting of an internal vertebral ossicle, surrounding dorsal, lateral and ventral arm plates, and associated structures.

ARM LENGTH. A body dimension of an ophiuroid measured from the edge of the disc to the tip of an arm.

ARM SPINES. Spines attached to the lateral arm plate in ophiuroids, and to the marginal plates in asteroids.

ARMAMENT. A general term which describes an echinoderm's array of spines and/or pedicellariae.

ASEXUAL REPRODUCTION. Reproduction that occurs without the fusion of male and female gametes, usually by splitting of the body into two parts that regenerate. The genetically identical offspring of asexual parents are a clone.

AUTOEVISCERATION. In holothuroids, expulsion of the digestive tract and associated organs through the anus; in some species, the anterior end of the body ruptures and the calcareous ring and associated organs are expelled. Believed to be a defensive mechanism.

AUTOTOMY. A defensive process of self-mutilation initiated in response to adverse stimuli. It involves loss of portions of the body, such as the arms or disc in

ophiuroids.

BASAL. In crinoids, one of a circlet of five plates that form part of the calyx.

BASKET. See OSSICLE TYPES.

BILATERAL SYMMETRY. A pattern of symmetry, based upon an anterior-posterior axis, in which the left side of the body is a mirror image of the right side.

BINARY FISSION. See FISSION.

BIPINNARIA. A free-swimming larval stage of asteroids. Bipinnaria larvae have blunt larval appendages which support a ciliated band. The bipinnaria either may develop into a BRACHIOLARIA larva, or it may undergo metamorphosis during which the juvenile arises on the left side of the larval body.

BROODING. Reproductive mode in which the embryos are protected on, in, or beneath the parent, and emerge as tiny, crawl away juveniles.

BUCCAL. Lying within the mouth.

BURSA. In ophiuroids, an organ within the disc formed by an inpouching of epidermis (see BURSAL SLIT). Bursae function as respiratory structures and are associated with the gonoducts. They house the developing embryos of brooding species.

BURSAL SLIT. The opening of a bursa, located on the ventral interradius of the disc at the base of the arm. There generally is one bursal slit on each side of an arm.

BUTTON. See OSSICLE TYPES.

CALCAREOUS RING. A ring of large ossicles surrounding the holothurian esophagus. It forms a point of insertion for longitudinal muscles and, when present, retractor muscles.

CALCITE. The mineral form of calcium carbonate that makes up the echinoderm skeleton.

CALYX. The cuplike central portion of the crinoid body, which supports the arms and visceral mass.

CARINAL PLATES. In asteroids, plates forming a keel or ridge along the abactinal

surface of an arm.

CENTRODORSAL. The middle ossicle attached to the aboral surface of the crinoid calyx; commonly carries cirri.

CIDAROIDS. A subclass of echinoids which arose in the Triassic; typified by species that have few, large, solid spines.

CIRRI. The unbranched, jointed appendages arising from the crinoid centrodorsal (sing. **CIRRUS**); they are used for attachment to the substratum.

CLOACA. In holothuroids, the posterior part of the intestine; it carries the openings to the respiratory trees and cuvierian tubules, when present.

COMMENSAL. An organism that lives in association with another organism, and which usually benefits from the partnership without harming its host.

CONGENERS. The species belonging to a single genus.

CRENULATE. Grooved; refers to the ribbed edge of certain echinoid tubercles.

CUVIERIAN TUBULES. Defensive structures of some holothurians, discharged through the anus as sticky threads which entangle and discourage predators.

DENDRITIC. Branching in a tree-like manner, as in certain holothuroid tentacles.

DENTAL PAPILLAE. See **PAPILLAE**.

DERMIS. The stratum of cells beneath the epidermal covering of the body wall. In echinoderms, the skeleton develops in the dermis and is filled with dermal tissue.

DIGITATE. Fingerlike, or carrying fingerlike structures; applied to certain holothuroid tentacles.

DISC. The round or pentagonal central body region of ophiuroids and asteroids.

DISC DIAMETER. A body dimension of an ophiuroid measured from the distal edge of a pair of radial shields to the disc edge in the opposite interradius.

DISTAL. In a direction away from the center of the body; for example, towards the tip of the arm in asteroids, or the tip of a spine in echinoids.

DORSAL. In echinoderms, this term is variously applied. In asteroids, ophiuroids and

echinoids, it usually refers to the surface of the body that is opposite the mouth, the surface that is uppermost. In holothuroids, with mouth and anus at opposite ends of a cylindrical body, the uppermost surface is considered dorsal. In crinoids, by convention, the surface opposite the mouth is considered dorsal even though it is functionally the ventral (lower) side.

DORSAL ARM PLATE. A plate on the aboral surface of an ophiuroid arm joint; one of the plates on the aboral surface of an asteroid arm.

ECHINOPLUTEUS. The free-swimming larval stage of an echinoid. Echinoplutei have appendages that are supported by skeleton, and that bear ciliary bands. The process of metamorphosis in which a juvenile echinoid arises from a rudiment on the left side of the echinopluteus body is completed in only a few minutes.

ECHINULATE. Something spiny or prickly, usually referring to the microscopic texture of a skeletal element such as a spine.

EMBRYO. An early developmental stage that is enclosed in a fertilization membrane or protected by the body of the parent. It transforms into a juvenile through metamorphosis.

EPT (= EXPANDED PERIPHERAL TRABECULAE). Microscopic, transparent nodules on the surface of skeletal plates. In ophiocomid ophiuroids they are a component of a photoreceptor system.

EIVISCERATION. See AUTOEIVISCERATION.

FASCIOLES. In many IRREGULAR ECHINOIDS, narrow bands of small, specialized spines; visible on the denuded test as bands of densely packed, tiny tubercles. Fascioles provide a flow of water to aid in respiration.

FENCE PAPILLA. See PAPILLAE.

FISSION. Asexual reproduction by splitting of the body into two parts, each of which regenerates into a complete animal.

FOOD GROOVE. In crinoids, furrows lined with cilia, which conduct particles of food

from the pinnules to the arms, and then on to the mouth (see AMBULACRAL GROOVE).

FUSIFORM. Shaped like a spindle, broadest in the middle and tapering towards each end.

GAMETOGENESIS. The process of formation of reproductive cells, eggs, and sperms.

GENITAL PAPILLA. In ophiuroids, granules or spinules attached to the edge of the bursal slit. The term is also used (perhaps more appropriately) for the fleshy outlets of the gonoducts in ophiuroids that lack bursae, and in some echinoids. In holothuroids, a single, fleshy genital papilla opens to the exterior on the dorsal surface of the body immediately posterior to the tentacles.

GENITAL PINNULE. In crinoids, a pinnule that is distal to the oral pinnules that contains gonad tissues.

GENITAL PLATE. In ophiuroids, a bar-like ossicle connecting the radial shield to the arm and supporting the radial edge of the bursal slit.

GLOBIFEROUS PEDICELLARIA. A three-valved echinoid pedicellaria that is equipped with venom sacs.

GONODUCT. Genital duct. A duct which carries eggs or sperms from the gonad to an external genital opening.

GRANULES. See SKELETAL ELEMENTS.

HEART URCHIN. A more or less heart-shaped burrowing echinoid, usually in the order Spatangoida.

HOOKS. Minute, moveable, crescentic ossicles that articulate with the dorsal arm scales in gorgonocephalid ophiuroids (other ophiuroids may have hook-shaped arm spines attached to the lateral arm plates).

INFEROMARGINALS. In asteroids, a row of plates that define the ventral edge of the body; inferomarginals are overlain by a row of SUPEROMARGINALS.

INFRADENTAL PAPILLAE. See PAPILLAE.

INTERAMBULACRUM. An oral or aboral sector of the body lying between two ambulacra. An interradius.

INTERRADIAL (INTERRADIUS, INTERRADII). Referring to interambulacral sectors of the body.

INTROVERT. In some holothurians, the anterior of the body including tentacles and associated structures. It can be withdrawn into the body by means of retractor muscles.

IRREGULAR ECHINOID. A heart-shaped or disc-shaped echinoid, usually covered with very short spines, generally living in or on soft sediment. Irregular echinoids have some degree of bilateral symmetry, as the anus is not at the center of the dorsal surface.

JAW. A moveable triangular structure that extends into the mouth in ophiuroids and asteroids. In the latter group, it is also referred to as a mouth-angle plate.

JOINT. See ARM JOINT.

LABRUM. A posterior or lower projection of the border of the mouth in irregular echinoids.

LAPPETS. In crinoids, small moveable plates that support the tube feet and form a protective covering over the food grooves.

LARVA. An early developmental stage that is independent of the fertilization membrane and the parent (pl. LARVAE). Through metamorphosis it transforms into a juvenile.

LATERAL ARM PLATES. In ophiuroids, paired plates covering the sides of each arm joint and bearing the arm spines.

LECITHOTROPHY. A mode of reproduction in which free-swimming larvae develop using nutrient laid down in the egg. Lecithotrophic larvae do not feed on particulate matter, but they may supplement yolk reserves by the uptake of

nutrients dissolved in seawater.

LUNULE. A slit in the echinoid test, as in the five or six-holed sand dollars.

MADREPORITE. A plate with numerous perforations that is connected to the water-vascular ring by a so-called stone canal. In most holothuroids it is internal. In asteroids and echinoids it opens to the exterior on the dorsal surface of the body; in ophiuroids it opens on the ventral surface, near the mouth. Crinoids lack a madreporite, having instead a series of small pores in the tegmen, opening to the body cavity.

MARGINALS. In asteroids, plates covering the sides of the arms.

MILIARY GRANULE. See OSSICLE TYPES.

OCULAR PLATE. A plate in the APICAL SYSTEM of echinoids. The five ocular plates are radial (ambulacral) in position, and new ambulacral plates develop at their distal edges. In asteroids, the most distal plate of the arm, enclosing the terminal tube foot.

OPHIOPLUTEUS. The free-swimming larval stage of an ophiuroid. Ophioplutei have appendages that are supported by skeleton and bear ciliary bands. During metamorphosis, the juvenile ophiuroid develops from a rudiment on the ventral surface of the larva; the process may involve resorption or loss of parts of larval structures.

OPTIC CUSHION. A pigmented light-sensory structure of asteroids, projecting from the base of the ventral surface of the terminal tube foot.

ORAL. In a direction towards the mouth; a part of the body on the same surface as the mouth.

ORAL PAPILLAE. See PAPILLAE.

ORAL SHIELD. A relatively large plate at the distal end of the ophiuroid jaw. At least one of the oral shields is modified as a madreporite.

ORAL TENTACLES. In ophiuroids, tube feet inside the mouth, arising from the jaws.

Also referred to as ORAL TUBE FEET.

OSSICLE. A small, usually microscopic skeletal element, embedded in integument.

Commonly found in the body wall of holothurians, but also known from the body wall and body cavity tissues of other echinoderms (e.g., the ophiuroid stomach) and the tube feet of echinoids and asteroids. The term is sometimes used to refer to all skeletal elements, especially in crinoids.

OSSICLE TYPES. In holothuroids, the various types of microscopic skeletal ossicles can be broadly classified, based on their shapes. The shanks of fluked **ANCHORS** are associated with shield-shaped **ANCHOR PLATES** in the body wall of synaptid holothuroids. **BASKETS (CUPS)** are minute cup-shaped ossicles usually with four perforations. **BUTTONS** are minute, flat, with few perforations; they may be smooth or knobbed. Solid, irregularly-shaped **MILIARY GRANULES** are found in the body wall and muscles of apodous holothuroids. Sieve-like **PERFORATED PLATES** are widespread in holothuroids, and may be found in other echinoderm classes, especially in juvenile individuals. **RODS** are commonly found as supporting structures in tentacles or tube feet. **ROSETTES** are tiny ossicles formed by dichotomous branching of rods in a single plane. **TABLES** consist of a basal perforated disc and a central spire composed of three or more rods joined by crossbars. **WHEELS** are common in some apodous holothuroids, they usually have six spokes and a serrated rim.

PAPILLAE. In holothuroids, specialized dorsal tube feet that lack a suckered tip. In ophiuroids, certain skeletal elements of the jaws or disc: **DENTAL PAPILLAE** - a cluster of small, blunt, spinelike structures on the dental plate, near the ventral tip of the jaw. **FENCE PAPILLAE** - peg-shaped spinelets fringing the edge of the disc of *Ophiophragmus* species. **INFRADENTAL PAPILLAE** - in amphiuroid ophiuroids, a pair of small, blocklike plates attached at the ventral tip of the jaw,

below the teeth. ORAL PAPILLAE - small plates at the edge of the mouth, attached to the edges of the jaw plate and/or the to adoral shield. Oral papillae can be variously shaped, from spinelike to scalelike. Also see GENITAL PAPILLAE.

PAPULAE. Small, soft, retractable extensions of the body cavity that project through pores in the body wall of asteroids; used for respiration. Papulae may be finger or glove-shaped, and are sometimes arrayed in dense patches.

PAXILLAE. In some asteroids, columnar plates that bear an apical cluster of spinelets or granules.

PAXILLATE. In asteroids, carrying paxillae.

PEDICELLARIAE. Small stalked or unstalked pincer-like organs on the body of asteroids and echinoids, used for defense and grooming.

PELTATE. Shield-shaped; used to describe the tentacles of some holothuroids.

PENICILLATE TUBE FOOT. In some echinoids, a long, extensible tube foot bearing a brush-like array of glandular projections at the tip.

PENTACTULA. The post-metamorphic developmental stage of holothuroids with either planktotrophic or lecithotrophic larvae. It has an anterior mouth and buccal podia, and one or two tube feet.

PERFORATE TUBERCLE. In echinoids, a primary or secondary tubercle with an apical perforation for the insertion of a ligament.

PERFORATED PLATE. See OSSICLE TYPES.

PERIPETALOUS. In echinoids, refers to a FASCIOLE which runs around the distal extremities of the anterior and posterior petals (ambulacra I, II, IV, V) and crosses ambulacrum III.

PERIPROCT. In echinoids the area of the test, commonly plated, which carries the anus.

PERISTOME. In echinoids, the area of the test which carries the mouth. The surrounding peristomial membrane is commonly plated.

PERRADIAL. In echinoids, having a meridional position at the midline of an ambulacrum.

PINNATE. Feather-like.

PINNULAR COMB. A group of modified pinnulars (see PINNULE) of an oral pinnule, which has a comblike profile. Present in Comasteridae and some Antedonidae.

PINNULE. In crinoids, an unbranched appendage arising from a brachial ossicle and composed of a series of pinnular ossicles.

PLANKTOTROPHY. The mode of development of free-swimming larvae that feed on particulate matter. Planktotrophic larvae grow using nutrients obtained from the plankton.

PLATES. See SKELETAL ELEMENTS.

POLIAN VESICLE. Fluid-filled sacs attached to the water-vascular ring. They act as reservoirs, holding fluid that is displaced when tube feet contract.

POLYPOROUS. In echinoids, a compound ambulacral plate with many pore pairs, usually five or more.

PORE PAIR. Ambulacral pore divided by a skeletal wall, through which a single tube foot passes.

PRIMARY PLATES. The first-formed plates on the dorsal side of the disc. In ophiuroids, for example, these are the CENTRAL and five RADIAL PLATES. In adults, they may form a rosette of scales near the center of the disc, or they may be separated by numerous secondarily developed scales.

PRIMARY SPINES. In echinoids, the first-formed, larger spines; carried on primary tubercles in ambulacra and interambulacra.

PROXIMAL. Towards the center of the body.

R. A body dimension of an asteroid, the major radius, measured from the center of the disc to the tip of the longest arm.

r. A body dimension of an asteroid, the minor radius, measured from the center of the disc to the edge of the disc in the middle of an interradius.

RADIAL. In a direction towards the central axis of an arm or ambulacrum; a part of the body near an arm or ambulacrum.

RADIAL SHIELDS. Pairs of plates on the dorsal surface of the ophiuroid disc, which lie near the base of each arm. They are usually relatively large and conspicuous, but may be hidden by granules or superficial scales.

RADIAL SYMMETRY. A pattern of symmetry in which identical segments of the body are arranged around a central axis. Echinoderms generally have a five-part (pentamerous) radial symmetry.

REGULAR ECHINOID. A more or less spherical echinoid, with long spines, and with the anus situated at the center of the aboral surface. Typically lives on hard bottoms, or among marine plants.

RESPIRATORY TREES. Paired respiratory organs of some holothuroids. They are attached to the cloaca, just inside the anus, and project anteriorly in the body cavity.

RETRACTOR. In holothurians, one of five muscles which act to pull the tentacles into the safety of the buccal cavity.

RHEOPHILIC. Literally, "current-loving." Rheophilic organisms prefer habitats with significant water movement. RHEOPHOBIC organisms avoid currents, and occupy sheltered positions or are restricted to low-energy habitats.

ROD. See OSSICLE TYPES.

ROSETTE. Modified basal ossicles of some crinoids; a microscopic ossicle of some

holothuroids (see OSSICLE TYPES).

SCALES. See SKELETAL ELEMENTS.

SCROBICULAR. In echinoids, surrounding the base of a spine.

SECONDARY SPINES. In echinoids, the smaller spines carried on secondary tubercles in the ambulacra and interambulacra (see PRIMARY SPINES).

SENSORY CUP. A stalked cup-like sensory organ on the tentacle stems of some holothuroids.

SKELETAL ELEMENTS. Supporting and protective dermal structures consisting of a calcite meshwork (stereom) and invested with a thin layer of tissue (stroma). Various skeletal elements are distinguished as follows: PLATES are tabular structures with a characteristic shape and a fixed position; SCALES are flat, thin structures that are overlapping, tessellate, or haphazardly arrayed; SPINES are moveable, articulating structures that are long, slender, and attenuated. Small structures fixed to the surface of scales or plates include: GRANULES that are minute and nearly equidimensional, SPINELETS that are enlarged, elongate cylindrical, or angular granules (this term is sometimes applied to small spines), SPINULES that have various numbers of pointed apical projections (e.g. bifid, trifid, multifid). Also fixed, and relatively larger than granules, are small structures referred to as STUMPS, which are usually prickly, and TUBERCLES which are smooth and more massive. In addition, TUBERCLES (see below) can refer to outgrowths of plates, rather than to articulated elements. Also see PAPILLAE.

SOLE. In some holothuroids, the flattened ventral part of the body, either covered with tube feet or surrounded by feet.

SPHAERIDIA. Orientation organs generally situated near the mouth of echinoids, consisting of a tiny spine with a swollen tip, set in a pit or a closed chamber.

SPINELETS. See SKELETAL ELEMENTS.

SPINES. See SKELETAL ELEMENTS.

SPINULES. Small, usually sharp-pointed, spines.

STATOCYST. In some holothurians, a sensory organ of balance, consisting of a hollow sphere lined by sensory receptor cells, which contains moveable granules.

STONE CANAL. A tube, usually reinforced with ossicles, leading from the madreporite to the water-vascular ring canal.

SUPEROMARGINALS. In asteroids, a row of plates defining the dorsal edge of the body. They overlie a row of INFEROMARGINALS.

TABLE. See OSSICLE TYPES.

TABULATE. Of spines, with a flat upper or distal surface.

TEETH. In ophiuroids, small plates or spines attached to the dental plate on the inner edge of the jaw, a series extending into the mouth. In echinoids, the five hard, sharp, and moveable ossicles incorporated in ARISTOTLE'S LANTERN.

TEGMEN. The surface of the crinoid visceral mass that bears the mouth and confluent food grooves leading to the arms, as well as the anus. It may be naked or reinforced with ossicles or plates.

TENTACLE PORE. In ophiuroids, an opening between the ventral arm plate and the lateral arm plate, through which a tube foot projects. Each arm joint has two tentacle pores.

TENTACLE SCALES. Small, moveable spines or scales, associated with ophiuroid tube feet, which are attached to the ventral arm plate and/or lateral arm plate. Tentacle scales may cover the tentacle pores and protect the retracted tube feet.

TENTACLES. In holothuroids, feeding structures in the form of highly modified tube feet arranged in a ring around the mouth.

TEST. The "shell" of an echinoid, made up of many small skeletal plates. A "naked" test

is one from which soft tissue, and projecting structures such as spines, have been removed. This process occurs naturally after the death of a sea urchin. To identify some urchins, it is necessary to clean a portion of the test with bleach, to see the underlying plates.

TRIFID. Divided into three parts. Regarding "trifid spinule" see SKELETAL ELEMENTS.

TRIGEMINATE. Of an echinoid ambulacral plate, have three pore-pairs.

TUBE FEET. Fluid-filled, fingerlike extensions of the water vascular system that protrude through openings in the skeleton or between skeletal elements. Muscles and nerves in the shaft of the tube feet control its movements; glands (and sometimes a muscular sucker) at the tip function in adhesion. Specialized tube feet are used for locomotion, feeding, burrowing, respiration, and a combination of functions (see PAPILLAE, TENTACLES).

TUBERCLE. A rounded prominence on the skeleton. In echinoids and some asteroids, a spine articulates with a tubercle (also, see SKELETAL ELEMENTS).

TUBERCULATED. Carrying numerous tubercles.

VENTRAL. In echinoderms, this term is variously applied. In asteroids, echinoids, and ophiuroids, it is the surface of the body that carries the mouth; this surface is in contact with the substrate. In the holothuroids, with mouth and anus at opposite ends of a cylindrical body, the ventral surface is lowermost - in contact with the substrate. In crinoids, the ventral surface carries the mouth, and is functionally the uppermost surface.

VENTRAL ARM PLATE. A plate on the oral surface of each ophiuroid arm joint; one of the plates on the oral surface of an asteroid arm.

VERMIFORM. Worm shaped.

VERTEBRA. An internal ossicle within every ophiuroid arm joint, connected by ligament and muscle to the vertebrae of adjacent joints. It is so named because of

a resemblance to bones in the human spinal column.

VITELLARIA. A type of free-swimming lecithotrophic echinoderm larva. It is barrel-shaped, has several transverse rings of locomotory cilia, and lacks a mouth.

WHEEL. See OSSICLE TYPES.