Bio1130- Organismal Biology
Key Words: Final Exam

Cambrian and Ordivician:

Acoelomate: Describing any bilaterally symmetrical animal of the subkingdom Eumetazoa that does not possess a coelom. Examples of acoelomate animals are the platyhelminths.

Algal Mats: a layer of usually filamentous algae on marine or fresh water soft bottoms. It may be considered one of many types of microbial mats.

Amoebocyte: an animal cel whose location is not fixed and is therefore able to wander through the body tissues. Amoebocytes are named after their resemblance, especially in their movement, to Amoeba and they feed on foreign partices (including invading bacteria). They occur, for example, in sponges and mammalian blood. (eg some leukocytes)

Archenteron: a cavity within an animal embryo at the gastrula stage of development. All or part of the archenteron eventually forms the cavity of the gut. It is connected to the outside by an opening (the blastopore), which becomes either the mouth, the mouth and anus or the anal opening of the animal.

Archeocyte: Archaeocytes or amoebocytes are amoeboid cells found in sponges. They are totipotent and have varied functions depending on the species.

Assymetric Body Plan: Assymetrical animals (sponges) have no general body plan or axis of symmetry that divides the body into mirror image halves. Within the animal kingdom this appears to be a primitive condition.

Bilateral Symmetry Body Plan: A basic body plan in which the left and right sides of the organism can be divided into approximate mirror images of each other along the midline.

Bivalvia: A class of aquatic molluscs (the bivalves) that inclue the oysters, mussels and clams. They are characterized by a laterally flattened body and a shell consisting of two hinged shells (ie. a bivalve shell). The enlarged gills are covered with cilia and have the additional function of filtering microscopic food particles from the water flowing over them. Bivavles live on the sea bed or lake bottom and are sedentary, so the head and foot are reduced.

Blastopore: a Blastopore is an opening into the archenteron during the embryonic stages of an organism. The distinction between protostomes and deuterostomes is based on the direction in which the mouth develops in relation to the blastopore.

Blastula: The stage of development of an animal embryo that results from cleavage of a fertilized egg. This stage generally resembles a hollow ball with the dividing cells (blastomeres) of the embryo forming a layer (blastoderm) around a central cavity (blastocoel). In vertebrates the blastula forms a disc (blastodisc) on the surface of the yolk. In mammals, the blastula stage is known as a blastocyst.

Bryozoa: A phylum of aquatic, mainly marine, invertebrates comprising the moss animals and sea mats. Bryozoans live in colonies, 50 cm or more across, which are attached to rocks, seaweeds or shells. The individuals (zooids) making up the colonies are about 1mm long and superficially resemble cnidarian polyps, with a mouth surrounded by ciliated tentacles of the lophophore that trap minute particles of organic matter in the water. Some have a horny or calcareous outer skeleton into which the body can be withdrawn. Bryozoans are placed in the clade of protostome animals called the Lophotrochozoa.

Burgess Shale Fossils: A rock formation in the western Canadian Rockies containing a wealth of fossilized invertebrates of the early Cambrian Period that were buried by an underwater avalanche of fine silt, preserving many details of their soft parts and providing valuable information about the evolution of early life.

Cambrian: The earliest geological period of the Paleozoic era. It is estimated to have begun about 542 million years ago and lasted for some 54 million years. During this period marine animals with mineralized shells made their first appearance and Cambrian rocks are the first to contain an abundance of fossils. Cambrian fossils are chiefly of marine animals; they include trilobites, which dominated the Cambrian seas, echinoderms, brachiopods, molluscs, and primitive graptolites (from the Mid Cambrian). Trace fossils also provide evidence for a variety of worms.

Cambrian Explosion: A relatively short interval of rapid intense evolution that supposedly occurred in the early to mid-Cambrian period, some 540 to 520 millions years ago. The supposition is based on the sudden appearance in the fossil record from this times of many diverse and novel forms, particularly marine animals, among which can be found representatives of all major modern groups. Notable well-preserved fossil assemblages dating to this period include the Burgess Shale fossils of Canada and the Chengjiang fossils of China. There is debate about whether such an explosion actually occurred or whether the evidence supporting it merely reflects discontinuity in the fossil record—that is, Precambrian ancestors of these fossil specimens did exist but were simply not fossilized.

Carnivores: An animal that eats meat, especially a member of the order Carnivora. Carnivores are specialized by having strong powerful jaws and well-developed canine teeth. They may be predators or carrion eaters.

Cephalization: the tendency among animal groups for the major sense organs, mouth and brain to be grouped together at the front end of the body. These are usually contained in a specialized cephalic region- the head.

Cephalopoda: The most advanced class of molluscs, containing the squids, cuttlefishes, octopuses and the extinct ammonites. Cephalopods have a highly concentrated CNS within a protective cartilaginous case. The eye has a well developed retina and is comparable to that of vertebrates. All cephalopods are predacious carnivores capable of swimming by jet propulsion; they have highly mobile tentacles for catching and holding prey.

Choanocyte: A flagellated cell with a collar of protoplasm at the base of the flagellum, numbers of which line the internal chambers of sponges.

Choanoderm: composed of flagellated collar cells, or choanocytes. The sponge body is mostly a connective tissue, the mesohyl, over which are applied epithelioid monolayers of cells, the outer pinacoderm and the inner choanoderm. Most aspects of sponge biology, including feeding, reproduction, and gas exchange, depend on a low pressure flow of water generated by the flagella of the choanoderm.

Cnidaria: A phylum of aquatic invertebrates (sometimes known as coelenterates) that includes Hydra, jellyfish, sea anemones, and corals. A cnidarians body is diploblastic with two cell layers of the body wall separated by mesoglea, and shows radial symmetry. The body cavity (gastrovascular cavity) is sac-shaped, with one opening acting as both mouth and anus. This opening is surrounded by tentacles bearing thread cells. Cnidarians exist both as free swimming medusa (ex jellyfish) and as sedentary polyps. The latter may be colonial (ex corals) or solitary (ex sea anemones and Hydra). In many cnidarians the life cycle alternates between these two forms. The phylum contains the classes of Hydrozoa, most members of which show alternation of generations; Scyphozoa (jellyfish) in which the medusa phase is dominant; and Anthozoa (corals and sea anemones) in which medusae are absent.

Cnidocil: A minute process of a nematocyst that when touched is believed to cause the projection of the stinging thread. (jellyfish)

Cnidocyte: A capsule, in certain cnidarians, containing a barbed, threadlike tube that delivers a paralyzing sting.

Coelom Formation: A fluid filled body cavity which is formed from the splitting of lateral plate mesoderm during embryonic development.

Coelomate: animals that have a coelom

Colonial Choanoflagellate: the series used to describe developmental stages of the parasitic flagellates, denoting the barleycom form of the flagellate in the genus crithidia characterized by a collarlike extension surrounding the anterior and through which the single flagellum emerges.

Corals: Any of a group of sedentary colonial marine invertebrates belonging to the class Anthozoa of the phylum Cnidaria. A coral colony consists of individual polyps within a protective skeleton that they secret: this skeleton may be soft and jelly like, horny or stony. The horny skeleton secreted by corals of the genus Corallium especially C. rubrum, constitutes the red, or precious coral used as a gemstone. The skeleton of a stony, or true corals consists of almost pure calcium carbonate and forms the coral reefs common in tropical seas.

Deposit (Substrate) Feeders: Any animal that feeds on the detritus that collects on the substratum at the bottom of water. Also known as detritus feeder.

Deuterosome: an animal in which the opening (blastopore) of the embryonic cavity becomes the anus and the mouth forms as a secondary orifice. The name derives from Greek, meaning literally "second mouth". Deuterostomes comprise one of the two main subkingdoms of animals (Deuterostomia), the other being the Protostomia. Deuterostomes typically display radial cleavage of the blastula, indeterminate developing (ie by outpocketing of the embryonic gut). The three deuterostome phyla are the Hemichordata, Echindodermata and Chordata.

Diploblastic: Describing an animal with a body wall composed of only two layers, ectoderm and endoderm, sometimes with a noncellular mesoglea between them. Coelenterates (ie cnidarians and ctenophorans) are diploblastic.

Doushantuo Fossils: aquatic, microscopic, and preserved to a great degree of detail. The latter two characteristics mean that the structure of the organisms that made them can be studied at the cellular level, and considerable insight has been gained into the embryonic and larval stages of many early creatures.

Ecdysis: The periodic loss of the outer cuticle of arthtropods. It starts with the reabsorption of some materials in the inner part of the old cuticle and the formation of a new soft cuticle. The remains of the old cuticle then split; the animal emerges and absorbs water or swallows air and increases in size while the new cuticle is still soft. This cuticle is then hardened with chitin and lime salts. In insects and crustaceans ecdysis is controlled by the hormone ecdysone.

Ecdysozoa: A clade of protostome animals, based chiefly on molecular systematics, whose members include the arthropods, nematodes, onychophorans, and tardigrades. All are characterized by their habit of periodic moulting (i.e. ecdysis, hence the name of the clade).

Ectoderm: The external layer of cells of the gastrula, which will develop into the epidermis and the nervous system in the adult.

Ediacaran Fossils: Relating to a group of fossilized organisms that are the earliest known remains of multicellular life. They are soft-bodied marine life forms that date from between 560 and 545 million years ago, during the late Precambrian Eon.

Ediacaran Period: a late Precambrian period of geological time, before the Cambrian Period to 635 million years ago; also, the last faunal stage of the Precambrian or Proterozoic

End Ordovician Extinction: The **End–Ordovician extinction event** is the third-largest extinction event of the Phanerozoic era. The Ordovician period followed the Cambrian and was followed by the Silurian. There were no living things on the land except for bacteria and perhaps some single-celled algae. The biota was almost entirely marine. The extinction came in two steps, at the start and the finish of the *Hirnantian* stage, which was the last stage of the Ordovician.

1. Pre-event: warm climate, deep ocean anoxic event. ocean bottoms were *anoxic* (little or no oxygen). Black shales were laid down in deep ocean strata; carbonates laid down on oxygenated continental shelves.
2. First step: climate turns cold; turnover of water in seas. Rising anoxic water kills most of the plankton, and shrinking seas remove habitats. Cold stage with clear evidence of widespread glaciation.
4. Second step: warming ocean re-established; glaciers melt, anoxic conditions reach continental shelves and kills fauna again.

Basic mechanism: climate changes from very warm to very cold and back to very warm. Changes in ocean circulation were the results of the climate changes. Both benthic (ocean bottom) and pelagic fauna were faced with conditions they were unable to cope with. More than 100 invertebrate families becam extinct in the End–Ordovician extinction event, and a total of almost half the genera.[4] The brachiopods and bryozoans were decimated, along with many of the trilobite, conodont and graptolite families.

Endoderm: The internal layer of cells of the gastrula, which will develop into the alimentary canal (gut) and digestive glands of the adult.

Endoparasites: A parasite that lives inside its host's body

Enterocoel: a coelom or coelomic cavity, present in some invertebrates, which has developed from the wall of the archenteron.

Epidermis: **1** (in zoology) The outermost layer of cells of the body of an animal. In invertebrates the epidermis is normally only one cell thick and is covered by an impermeable cuticle. In vertebrates the epidermis is the thinner of the two layers of skin (compare dermis). It consists of a basal layer of actively dividing cells (see Malpighian layer), covered by layers of cells that become impregnated with keratin (see keratinization). The outermost layers of epidermal cells (the stratum corneum) form a water-resistant protective layer. The epidermis may bear a variety of

specialized structures (e.g. feathers, hairs). **2** (in botany) The outermost layer of cells covering a plant. It is overlaid by a cuticle and its functions are principally to protect the plant from injury and to reduce water loss. Some epidermal cells are modified to form guard cells (see stoma) or hairs of various types (see piliferous layer). In woody plants the functions of the shoot epidermis are taken over by the periderm tissues (see cork cambium) and in mature roots the epidermis is sloughed off and replaced by the hypodermis.

Epitheliomusculature: of or being an epithelial cell of coelenterates that is modified to function in contraction and has an elongated fibrillar base that functions in the same manner as a muscle cell

Filter Feeder: An aquatic animal, such as a clam, barnacle, or sponge, that feeds by filtering particulate organic material from water.

Gap Junctions: A passage through the lipid bilayers of adjacent plasma membranes that mediates the transfer of small molecules or ions between interacting cells. Gap junctions are abundant in epithelial tissues and cardiac muscle. They consist of hexagonally packed tubes (connexons), approximately 10 nm in diameter, through which small molecules or ions may directly pass from the interior of one cell to the interior of the other. Gap junctions, together with chemical synapses (which function through neurotransmitters), are **communicating junctions** and comprise one of several types of cell junction.

Gastrodermis: The epithelial lining of the digestive tract of certain invertebrates, including the nematode worms and coelenterates.

Gastropod: A class of molluscs that includes the snails, whelks, limpets, land and sea slugs, and conches. Molluscs have a well-developed head with tentacles, a large flattened foot, and a coiled twisted shell. They occupy marine, freshwater, and terrestrial habitats; in the terrestrial and some freshwater gastropods the mantle cavity acts as a lung instead of enclosing gills.

Gastrozooid: zooids in colonies of Coelenterates (hydropolyps, hydrocorals, and Siphonophores) that carry out the digestive function. They resemble polyps with partially or completely atrophied tentacles. Located nearby or at the base of the gastrozooid are zooids adapted for capturing prey (dactylozooids, stinging tentacles) and which transfer their prey to the gastrozooid for digestion.

Gastrula: The stage in the development of an animal embryo that succeeds the blastula. It begins with the production of the primary germ layers and the embryo becomes converted to a cup-shaped structure containing a cavity (the archenteron).

Gastrulation: (Science: embryology) During embryonic development of most animals a complex and co-ordinated series of cellular movements occurs at the end of cleavage. The details of these movements, **gastrulation**, vary from species to

species, but usually result in the formation of the three primary germ layers, ectoderm, mesoderm and endoderm.

Gonozooid: A sexual zooid, or medusoid bud of a hydroid; a gonophore. See Hydroidea, and Illust. of Campanularian.

Herbivores: An animal that eats vegetation, especially any of the plant-eating mammals, such as ungulates (cows, horses, etc.). Herbivores are characterized by having teeth adapted for grinding plants and alimentary canals specialized for digesting cellulose

Hermaphrodite: An animal, such as the earthworm, that has both male and female reproductive organs.

Homeotic Genes: A developmental gene that specifies the anterior-posterior axis, as well as segment identity during the early embryonic development of certain organisms, such as metazoans.

Homeotic Mutants: a mutation that causes tissues to alter their normal differentiation pattern, producing integrated structures but in unusual locations. For example, a homeotic mutation in the fruit fly, *Drosphila,* causes legs to develop where antennae normally form.

Hox Genes: A class of homeotic genes that control development of structures along the head-to-tail (anteroposterior) axis of a wide range of animals. The *Hox* genes are organized into clusters on certain chromosomes; jawed vertebrates, for example, have four *Hox* gene clusters. In mammals these four clusters are designated *Hox A, Hox B, Hox C, and Hox D*, each on a separate chromosome, with individual genes given numbers, hence, *A1*, *A2*, *B1*, *B2*, etc. Nematodes, arthropods, and cephalochordates have a single cluster. *Hox* genes are highly conserved, showing remarkable similarity of DNA sequence and function; each falls into one of several groups of paralogous genes, derived by duplication of ancestral genes. Moreover, in embryos of all animals studied, the *Hox* genes show **colinearity** – their sequence of expression in body segments from head to tail reflects their linear arrangement in the homeotic gene clusters.

Hydrostatic Skeleton: The system of support found in soft-bodied invertebrates, which relies on the incompressibility of fluids contained within the body cavity. For example, in earthworms the coelomic fluid is under pressure within the coelom and therefore provides support for internal organs.
Ingestive Heterotroph: Organisms that consume food and digest it inside their bodies.

Lophophore: An organ characteristic of aquatic invertebrates of the phyla Bryozoa, Phoronida, and Brachiopoda that functions in filter feeding. It consists of a ridge of hollow tentacles bearing cilia, which waft food particles into the mouth.

Lophotrochozoa: A clade of protostome animals, based on molecular systematics, that includes the molluscs and annelid worms, together with the nemertines, bryozoans, and other wormlike phyla.

Mantle: The fold of skin covering the dorsal surface of the body of molluscs, which extends into lateral flaps that protect the gills in the **mantle cavity** (the space between the body and mantle). The outer surface of the mantle secretes the shell (in species that have shells).

Medusa: The free-swimming stage in the life cycle of the Cnidaria. Medusae are umbrella-shaped, with tentacles round the edge and the mouth in the centre underneath. They swim by pulsations of the body and reproduce sexually. In the Hydrozoa (e.g. *Hydra*) they alternate in the life cycle with polyps, from which they are produced by budding. In the Scyphozoa, which includes all the common jellyfish, the medusa is the dominant form and the polyp is reduced or absent.

Mesoderm: The layer of cells in the gastrula that lies between the ectoderm and endoderm. It develops into the muscles, circulatory system, and sex organs and in vertebrates also into the excretory system and skeleton.

Mesoglea: The gelatinous noncellular layer between the endoderm and ectoderm in the body wall of coelenterates. It may be thin, as in *Hydra*, or tough and fibrous, as in the larger jellyfish and sea anemones. It often contains cells that have migrated from the two body layers but these do not form tissues and organs and the mesoglea is not homologous with the mesoderm of triploblastic animals.

Metamerization: the formation or differentiation of metameres

Mollusc: A phylum of soft-bodied invertebrates characterized by an unsegmented body differentiated into a **head**, a ventral muscular **foot** used in locomotion, and a dorsal **visceral hump** covered by a fold of skin – the mantle – which secretes a protective shell in many species. Respiration is by means of gills (ctenidia) or a lunglike organ and the feeding organ is a radula. Molluscs occur in marine, freshwater, and terrestrial habitats and there are six classes, including the Gastropoda (snails, slugs, limpets, etc.), Bivalvia (bivalves, e.g. mussels, oysters), and Cephalopoda (squids and octopuses).

Omnivores: An animal that eats both animal and vegetable matter. Pigs, for example, are omnivorous.

Onycophora: A small phylum of caterpillar-like invertebrates – the velvet worms – that inhabit moist dark terrestrial habitats, such as forest litter and caves, in tropical and warm regions. The thin chitinous cuticle, which bears numerous papillae and sensory hairs giving it a velvety feel, is periodically moulted. The 110 or so known species, which include *Peripatus*, are generally small, with brownish bodies,

although some are more brightly coloured. Sizes range from 14 mm to 200 mm in length, with females larger than males, and there may be from 14 to more than 40 pairs of unjointed hollow legs. Onychophorans capture prey, such as spiders and termites, by entangling them in a sticky secretion squirted from adhesive glands opening beside the mouth. The sexes are separate; some species lay eggs, whereas others are ovoviviparous or viviparous, the latter nourishing embryos internally via a placenta analogous to that of mammals. Onychophorans are closely related to arthropods and are thought to have descended from extinct marine forms that flourished in the Cambrian, such as *Aysheaia* and *Hallucigenia*, found in the Burgess shale deposits. Such fossil forms are now sometimes placed with modern velvet worms in the phylum **Lobopodia**.

Ootype: The production and growth of the ova (egg cells) in the animal ovary. Special cells (**oogonia**) within the ovary divide repeatedly by mitosis to produce large numbers of prospective egg cells (**primary oocytes**). When mature, these undergo meiosis, which halves the number of chromosomes. During the first meiotic division a **polar body** and a **secondary oocyte** are produced. At the second meiotic division the secondary oocyte produces an ovum and a second polar body. Oocytes may be present in the ovaries at birth and may represent the total number of eggs to be produced.

Ordovician Period: The second geological period of the Palaeozoic era, following the Cambrian and preceding the Silurian periods. It began about 488 million years ago and lasted for about 44 million years. The period was named by the British geologist Charles Lapworth (1842–1920) in 1879. Graptolites, in deep-water deposits, are the dominant fossils. Other fossils include trilobites, brachiopods, ectoprocts, gastropods, bivalves, echinoids, crinoids, nautiloid cephalopods, and the first corals.

Pentaramous Symmetry: Pentamerous radial symmetry describes an animal whose body can be divided into five parts that point outward from the center of the body. For example, sea stars, urchins, and brittle stars exhibit pentamerous radial symmetry.

Pinacoderm: The pinacoderm is the outer most layer of cells in the phylum Porifera, equivalent to the epidermis in other organisms. The pinacocytes are on the external surface of the sponge body and characterized as an epithelial layer of flattened cells.

Platyzoa: A clade of protostome animals based on molecular systematics and including the flatworms, rotifers, and certain other phyla.

Platyhelminthes: A phylum of acoelomate invertebrates comprising the flatworms, characterized by a flattened unsegmented body. The simple nervous system shows some concentration of cells at the head end. The mouth leads to a simple branched gut without an anus. Flatworms are hermaphrodite but self-fertilization is unusual. Many species are parasitic. The phylum contains the classes Turbellaria

(planarians), Trematoda (flukes), and Cestoda (tapeworms). Molecular evidence now suggests that the majority of flatworms are secondarily acoelomate and belong to the Platyzoa. This distinguishes them from those platyhelminths traditionally placed in the order Acoelomorpha, which are primitively acoelomate and descended from an ancient animal lineage that is neither protostome nor deuterostome

Polyp: The sedentary stage in the life cycle of the Cnidaria, consisting of a cylindrical body fixed at one end to a firm base and having a mouth surrounded by a ring of tentacles at the other. Some polyps (e.g. *Hydra*) are single; others (e.g. the corals and *Obelia*) form colonies. Polyps typically reproduce asexually by budding to form either new polyps or medusae. The latter reproduce sexually giving rise to new polyps. Sea anemones are solitary polyps that reproduce sexually to form new polyps.

Porifera: The phylum of marine and freshwater invertebrates that comprise the sponges, which live permanently attached to rocks or other surfaces. The body of a sponge is hollow and consists basically of an aggregation of cells between which there is little nervous coordination. The body is supported by an internal skeleton of spicules of chalk, silica, or fibrous protein (bath sponges have protein skeletons). Undulipodium-bearing (flagellated) cells (**choanocytes**) cause water to flow in through openings (**ostia**) in the body wall and out through openings (**oscula**) at the top; food particles are filtered from the water by the choanocytes.

Predators: An animal that obtains its food by predation. All predators are carnivores, although not all carnivores are predators.

Protostome: An animal in which the mouth develops from the opening (blastopore) of the embryonic cavity (see archenteron). The name derives from Greek, meaning literally 'first mouth'. Protostomes constitute one of the two major subkingdoms of animals (Protostomia), the other being the Deuterostomia (see deuterostome). Other features typical of protostomes are spiral cleavage of the blastula, determinate development (i.e. the fate of cells is established at a very early embryonic stage), and schizocoelic formation of a coelom where one occurs (i.e. by formation of a cavity within a solid mass of mesoderm). Three main clades of protostomes are now recognized: Ecdysozoa; Lophotrochozoa; and Platyzoa.

Pseudocoelomate: Describing any invertebrate animal whose body cavity is a **pseudocoel**, a cavity between the gut and the outer body wall derived from a persistent blastocoel (see blastula), rather than a true coelom. Pseudocoelomate animals include the Rotifera and Nematoda.

Radial Cleavage: holoblastic cleavage that is typical of deuterostomes and that is characterized by arrangement of the blastomeres of each upper tier directly over those of the next lower tier resulting in radial symmetry around the pole to pole axis of the embryo — compare spiral cleavage

Radial Symmetry Body Plan: a basic body plan in which the organism can be divided into similar halves by passing a plane at any angle along a central axis, characteristic of sessile and bottom-dwelling animals, as the sea anemone and starfish.

Radula: A tonguelike organ of molluscs, consisting of a horny strip whose surface is studded with rows of horny teeth for rasping food. In some species it is modified for scraping or boring.

Reefs: a ridge of jagged rock, coral, or sand just above or below the surface of the sea.

Schizocoel: a perivisceral cavity that arises by the splitting of the mesoblast of the embryo

Seminal Receptacle: Receives sperm from another worm

Seminal Vesicle: A pouch or sac in many male invertebrates and lower vertebrates that is used for storing sperm.

Setae: A bristle or hair in many invertebrates. Setae are produced by the epidermis and consist either of a hollow projection of cuticle containing all or part of an epidermal cell (as in insects) or are composed of chitin (as in the chaetae of annelid worms).

Slushball Earth: The "Slushball Earth" hypothesis, developed by American geologist Richard Cowen, contends that Earth was not completely frozen over during periods of extreme glaciation in Precambrian times. Rather, in addition to massive ice sheets covering the continents, parts of the planet (especially ocean areas near the Equator) could have been draped only by a thin, watery layer of ice amid areas of open sea. Under this scenario, photosynthetic organisms in low-ice or ice-free regions could continue to capture sunlight efficiently and survive long periods of extreme cold.

Snowball Earth: **Snowball Earth hypothesis,** in geology and climatology, an explanation first proposed by American geobiologist J.L. Kirschvink suggesting that Earth's oceans and land surfaces were covered by ice from the poles to the Equator during at least two extreme cooling events between 2.4 billion and 580 million years ago.

Spiral Cleavage: holoblastic cleavage that is typical of protostomes and that is characterized by arrangement of the blastomeres of each upper tier over the cell junctions of the next lower tier so that the blastomeres spiral around the pole to pole axis of the embryo

Sponges: The phylum of marine and freshwater invertebrates that comprise the sponges, which live permanently attached to rocks or other surfaces. The body of a

sponge is hollow and consists basically of an aggregation of cells between which there is little nervous coordination. The body is supported by an internal skeleton of spicules of chalk, silica, or fibrous protein (bath sponges have protein skeletons). Undulipodium-bearing (flagellated) cells (**choanocytes**) cause water to flow in through openings (**ostia**) in the body wall and out through openings (**oscula**) at the top; food particles are filtered from the water by the choanocytes.

Spongocoel: The central cavity of a sponge, which opens to the outside by way of the osculum

Suspension Feeders: an aquatic animal which feeds on particles of organic matter suspended in the water, especially a bottom-dwelling filter feeder.

Tagma: A section of the body of an arthropod that is formed by the fusion of mesodermal somites and has a distinct function and structure. The basic tagmata are the head, thorax, and abdomen, but the form of the tagmata (known as **tagmosis**) varies between arthropod groups, each group having its characteristic tagmosis. For example, many crustaceans have a cephalothorax and abdomen, while arachnids have a prosoma and opisthosoma.

Totipotent Cells: A cell that can give rise to the entire organism, including the extra-embryonic membranes; the fertilized egg or zygote is totipotent.

Triploblastic: Describing an animal having a body composed of three embryonic cell layers: the ectoderm, mesoderm, and endoderm. Most multicellular animals are triploblastic; the coelenterates, which are diploblastic, are an exception.

Trochophore: The pelagic planktonic larva of polychaete worms, some molluscs, and certain other invertebrates. It is top-shaped and usually has two bands of cilia encircling the body.

Tube Feet: A phylum of marine invertebrates that includes the sea urchins, starfish, brittlestars, and sea cucumbers. Echinoderms have an exoskeleton (**test**) of calcareous plates embedded in the skin. In many species (e.g. sea urchins) spines protrude from the test. A system of water-filled canals (the **water vascular system**) provides hydraulic power for thousands of **tube feet**: saclike protrusions of the body wall used for locomotion, feeding, and respiration. Echinoderms have a long history: fossils of primitive echinoderms are known from rocks over 500 million years old. Like chordates, they are deuterostomes. Extant classes include the Crinoidea (sea lilies), Holothuroidea (sea cucumbers), Echinoidea (sea urchins), and Stelleroidea (starfish and brittlestars).

<u>Silurian and Deconian:</u>

Actinopterygii: also known as ray-finned fishes, constitute a subclass of the bony fishes. They are called ray-finned because they possess “fin rays”, their fins being

webs of skin supported by bony or horny spines, as opposed to the fleshy, lobed fins that characterize the class Sarcopterygii which also, however, possess lepidotrichia.

Agnatha: Any jawless craniate animal. Agnathans were formerly classified in the subphylum (or superclass) Agnatha, with the living representatives. (ex lamprey)

Alternation of Generations: The occurrence in one life history of two or more different forms differently produced, usually an alternation of a sexual with an asexual form. The alternation of two or more different forms in the life cycle of a plant or animal. A unique occurrence where one generation reproduces sexually then the next reproduces asexually.

Antheridia: The male sex organ of algae, mosses, ferns, fungi and other non flowering plants.

Archegonia: The female sex organ in mosses, liverworts, ferns, and most conifers.

Arthropoda: A large phylum of invertebrate animals that includes insects, spiders, crustaceans, and their relatives. They have a segmented body, an external skeleton, and jointed limbs, and are sometimes placed in a different phyla.

Bony Fish: A fish of a large class distinguished by a skeleton bone, and comprising the majority of modern fishes.

Cartilagenous Fish: A fish of a class distinguished by having a skeleton of cartilage rather than bone, including the sharks, rays and chimaeras.

Chondricthyes: Jawed fish with paired fins, paired nares, scales, a heart with it's chambers in series and skeletons made of cartilage rather than bone.

Crustacean: form a very large group of arthropods, usually treated as a subphylum, which includes such familiar animals as crabs, lobsters, crayfish, shrimp, krill and barnacles.

Devonian Period: "The age of Fishes"; Fourth of six periods that make up the Paleozoic Era. During this period fish such as agnanthans and placoderms attained their highest levels of diversity. Additionally, true bony fishes and cartilaginous fishes first appeared and both groups are thought to have evolved from the placoderms.

External Fertilization: External fertilization is a strategy of fertilization in which a sperm cell unites with an egg cell in the open, rather than inside specialized organs within the bodies of the parents.

Gametangia: a gamentangium is an organ or cell in which gametes are produced that is found in many multicellular protists, algae, fungi and the gametophytes of plants.

Gametophyte: a gametophyte is a haploid multicellular adult stage in the alternation of generations during the life cycle of land plants and algae. It produces haploid gametes.

Gastropod: The gastropoda or gastropods, more commonly known as snails and slugs, are a large taxonomic class within the Phylum Mollusca. The class Gastropoda includes snails and slugs of all kinds and all sizes from microscopic to large.

Gemma and Gemma Cups: Gemma: a small cellular body or bud that can separate to form a new organism; Gemma cups: Part of a plant that appears as a cup like structure located on its surface. Gemma cups are common in asexual plants as this is their mode of reproduction. The gemma cups contain the reproductive cells called gemma which detages from the parent plants then buds after it has fragmented on the ground.

Gill Arches: One of several bony or cartilaginous arches located on either side of the pharynx and supporting the gills in fish and amphibians.

Gill Slits: One of several narrow external openings connecting with the pharynx, characteristic of sharks and related fishes, through which water passes to the exterior, thereby bathing the gills; One of the several rudimentary invaginations in the surface of the embryo, present during development of all air breathing vertebrates and corresponding to the functional gill slits of aquatic species.

Gnathostomes: Gnathostomata are the jawed vertebrates. The term derives from Greek “jaw” and “mouth”, and it includes all vertebrates except the agnathans.

Heterocercal Tail: (of a fishes tail) having unequal upper and lower lobes, usually with the vertebral column passing into the upper.

Jaw: each of the upper and lower bony structures in vertebrates forming the framework of the mouth and containing the teeth.

Lignin: a complex polymer of aromatic alcohols known as monolignols. It is most commonly derived from wood and is an integral part of the secondary cell walls of plants and some algae.

Mermaids Purse: The horny egg case of a skate, ray or small shark.

Mesozoic: Of, belonging to, or designating the era of geologic time that includes the Triassic, Jurassic and cretaceous periods and is characterized by the development of flying reptiles, birds and flowering plants and by the appearance and extinction of dinosaurs.

Neutral Buoyancy: a condition in which a physical body’s mass equals the mass it displaces in a surrounding medium. An object that has neutral buoyancy will neither

sink nor rise.

Opercular Gill: a lid or cover becoming detached at maturity by abscission, in eucalyptus for example, a cap covering the bud and formed by fusion or cohesion or perianth parts.

Ostracoderm: An early jawless fossil fish of the Cambrian to Devonian periods, having a heavily armoured body.

Pectoral Fin: each of a pair of fins situated on either side just behind a fish's head, helping to control the direction of movement during locomotion. They correspond to the forelimbs of other vertebrates.

Pectoral Girdle: a bony or cartilaginous structure in vertebrates, attached to and supporting the forelimbs or anterior fins. Aka pectoral arch.

Pelvic Fin: each of a pair of fins on the underside of a fish's body, attached to the pelvic girdle and helping to control direction.

Pelvic Girdle: the enclosing structure formed by the bony pelvis, providing attachment for the hindlimbs or pelvic fins.

Placoderm: a fossil fish of the Devonian period, having the front part of the body encased in broad flat bony plates.

Placoid Scale: (dermal denticles) are tough scales that cover the skin of sharks and rays. Even though placoid scales are similar to the scales of bony fish, they are really modified teeth and are covered with a hard enamel. Placoid scales are packed tightly together and grow with their tips facing backwards. This gives the fishes skin a rough feel. The function of the scales is for protection against predators, although in some sharks, they may also have a hydrodynamic function.

Primary Plant Cell Wall: a thin flexible and extensible layer of the cell wall composed of cellulose, pectin and hemicellulose.

Rhizoids: a filamentous outgrowth or root hair on the underside of the thallus in some lower plants, especially mosses and liverworts, serving both to anchor the plant and (in terrestrial forms) to conduct water.

Sarcopterygii: lobe-finned fish, constitute a clade of the bony fish, though a strict cladistics view includes the terrestrial vertebrates. The living sarcopterygians are the coelacanths, lungfish, and the tetrapods.

Secondary Plant Cell Wall: A thick layer, rich in lignin, that strengthens and waterproofs the wall and is formed inside the primary cell wall that has stop increasing in surface area when the cell is fully grown

Silurian Period: extends from the end of the Ordovician period to the beginning of the Devonian Period. The rock beds that define the periods start and end are well identified, but the exact dates are uncertain by several million years. A significant evolutionary milestone during this era was the appearance of jawed and bony fish,. Life also began to appear on land in the form of small, moss like vascular plants, which grew beside lakes streams and coastlines, and also in the form of small terrestrial arthropods.

Sporangia: a single celled or multi celled structure in which spores are produces, as in fungi, algae, mosses and ferns.

Spores: a unit of asexual reproduction that may be adapted for dispersal and for survival, often for extended periods of time, in unfavorable conditions.

Sporophyte: the diploid multicellular stage in the life cycle of a plant or alga; develops from the zygote produced when a haploid egg cell is fertilized by a haploid sperm and each cell therefore has a double set of chromosomes, one set from each parent. Sporophyte produces spores by meiosis.

Stomata: a pore found in the epidermis of leaves, stems and other organs that is used to control gas exchange.

Suction Feeding: feeding through suction (sucking)

Swim Bladder: an internal gas filled organ that contributes to the ability of a fish to control is buoyancy, and thus to stay at the current water depth without having to waste energy in swimming.

Tetrapod: the superclass tetrapoda, or the tetropods, comprises the first four limbed vertebrates and their descendant, including the living and extinct amphibians, reptiles, birds, and mammals.

Thallus: the undifferentiated vegetative tissue of some organisms in diverse groups such as algae, fungi, some liverworts, lichens, and the Myxogastria; a plant body that is not differentiated into stem and leaves and lacks true roots and a vascular system.

Tracheids: a type of water conducting cell in the xylem of vascular plants which lacks perforations in the cell wall.

Carboniferous and Permian:

Abdomen: The posterior segment of invertebrates, after the thoracic segment.

Albumen: The major plasma protein responsible for the plasma colloidal osmotic pressure. It's role is to transport protein carrying large organic anions (ex fatty acids, bilirubin, and many drugs) certain hormones (cortisol and thyroxine) when

the specific binding globulins are saturated. Refers to generally any protein with water solubility, which is moderately soluble in concentrated salt solutions and experiences heat coagulation.

Allantois: the fetal membrane lying below the chorion in many vertebrates, formed as an outgrowth of the embryo's gut. In birds and reptiles it grows to surround the embryo; in eutherian mammals it forms part of the placenta.

Ametabolous Metamorphosis: Dexcribing insect development in which there is no metamorphosis and immature stages appear very similar to the adults, except that they lack genetalia. It occurs for example, in silverfish.

Amnion: A thin, tough, membranous sac that encloses the embryo or fetus of a mammal, bird or reptile. It is filled with a serous fluid in which the embryo is suspended.

Amniotes: Any of a group of vertebrates that have an amnion during embryonic development, including reptiles, birds and mammals.

Amphibia: The class of vertebrates that live on land but breed in water: frogs, toads. Newts, salamanders, caecilians.

Arbuscular Mycorrhizal Fungi: a type of mycorrhiza in which the fungus penetrates the cortical cells of the roots of a vascular plant. They are characterized by the formation of unique structures, arbuscules and vesicles by fungi of the phylum Glomeromycota. AM fungi help plants to capture nutrients such as phosphorus, sulfur, nitrogen and micronutrients from the soil.

Archegonium: a multicellular structure or organ of the gametophyte phase of certain plants, producing and containing the ovum or female gamete. The corresponding male organ is called the antheridium.

Ascocarp: the fruting body of an ascomycete fungus. It consists of very tightly interwoven hyphae and may contain millions of asci, each of which typically contain eight ascospores. Ascocarps are most commonly bowl shaped but may take on a number of other forms.

Ascomycota: a division/phylum of the kingdom Fungi that, together with the Basidiomycota, form the subkingdom Dikarya. Its members are commonly known as the sac fungi.

Ascus: a sac, typically cylindrical in shape, in which the spores of ascomycete fungi develop.

Background Extinction: the ongoing extinction of individual species due to environmental or ecological factors such as climate change, disease, loss of habitat,

or competitive disadvantage in relation to other species. Background extinction occurs at a fairly steady rate over geological time and is the result of normal evolutionary processes, with only a limited number of species in an ecosystem being affected at any one time.

Basidium: microscopic, spore producing structure found on the hymenophore of fruiting bodies of basisiomycete fungi. The presence of basidia is one of the main characteristic features of the Basidiomycota. The hymenium is the tissue layer on the hymenophore of a fungal fruiting body where the cells develop into basidia or asci which produce spores.

Basidyomycota: a phylum of fungi, characterized by a spore bearing organ the basidium, that is usually a clavate cell that bears basidiospores after karyogamy and meiosis. Some mycologists have raied the class basidiomycetes to the phylum or division level.

Carboniferous Period: Also known as “The Age of Amphibians” the fifth of six periods during the Paleozoic era. It is preceeded by the Devonian period and followed by the Permian period. This period saw the first true bony fishes, the first sharks and the first amphibians evolve. It also was the time period during which the first amniotes arose. The amniotic egg, the defining characteristic of amniotes, enabled the ancestors or modern reptiles, birds and mammals to reproduce on land and colonise terrestrial habitats that were previously uninhabited by vertebrates.

Chorion: The outermost membrane surrounding an embryo of a reptile, bird or mammal. In mammals in contributes to the formation of the placenta. The noncellular membrane covering eggs of various animals ex fish and insects.

Circular Muscle: Muscle layer encircling the body between the epidermis and longitudinal muscle layer.

Clitellum: A swollen, glandular, saddlelike region in the epidermis of certain annelid worms, such as the earthworm, that secretes a viscous fluid to form a cocoon for their eggs.

Coal Forests: the vast swathes of wetlands that covered much of the Earth’s tropical land areas during the late Carboniferous and Permian times. As vegetable matter from these forests decayed, enormous deposits of peat accumulated which later changed into coal.

Complete Metamorphosis: a kind of metamorphosis in which insects undergo complete physical change i.e developing and going through four life stages: embryo, larva, pupa and imago.

Cuticle: a continuous layer of waxy subtances covering over the outer surfaces of the epidermis of plants, it contains cutin and protects against water loss/water gain and

other damage. Hard outer covering or case of certain organisms such as arthropods and turtles.

Dikaryotic: The state in certain fungi in which each compartment of a hypha contains two nuclie, each derived from a different parent.

Ectomycorrhiyzal Fungi: economically, one of the most important groups of fungi. These are the fungi that form a symbiotic relationship with a plant forming a sheath around the root tip of the plant. The fungus then forms a Hartig Net which means that there is an inward growth of hyphae (fungal cell growth form) which penetrates the plant root structure. There are actually seven type of mycorrhiza and 90% of plants form myocorrhiza with fungi, but ectomycorrhizal refers to this sheath forming type.

Epicuticle: the thin, waxy protective outer layer covering the surfaces of some plants, fungi, and insects and other arthropods.

Exoskeleton: the external skeleton that supports and protects an anima's body, in contrast to the internal skeleton of, for example a human. In popular usage, some of the larger kinds of exoskeletons are known as "shells"

Flood Basalts: the result of a giant volcanic eruption or series of eruptions that coats large stretches of land or the ocean floor with basalt lava.

Gas Hydrates: an ice-like crystalline solid formed from a mixture of water and natural gas, usually methane. They occue in the pore spaces of sediments, and may form cements, nodes or layers.

Gymnosperm: a group of seed producing plants that includes conifers, cycads, Ginkgo, and Gnetales. The term "gymnosperm" comes from the greek word gymnospermos, meaning "naked seeds" after the unenclosed condition of their seeds.

Head: The cephalic part of an organism, especially the body part containing the brain and/or most organs used for feeding and/or sensing. In some animals, the head is not found on the topmost anterior part of their body. For instance, the squids have head-foot in which their arms and tentacles are located. Other animals such as sea starts have no distinctive head. Sea stars have eyespots at the tip of the arms mouth at the center and no centralized brain.

Hermaphrodite: an organism having both male and female reproductive organs and capable of producing both male and female gametes.

Heterokaryotic: refers to cells where two or more genetically different nuclei share one common cytoplasm. It is antonym of homokaryotic.

Heterosporous: producing two types of spores differing in size and sex.

Homosporous: producing spores of one kind only.

Hydrostatic Skeleton: a formation found in both the numerous cold blooded organisms and soft bodied animals. Examples of such animals are earthworms, jellyfish, invertebrates and starfish.

Hyphae: the fine, branching tubes which make up the body of a multicellular fungus.

Incomplete Metamorphosis: when insects change how they look and what they can do when they grow. Insects that have incomplete metamorphosis have three different life stages.

Insecta: a class of invertebeates within the arthropod phylum that have a chitinous exoskeleton, a three part body, three pairs of jointed legs, compound eyes and one pair of antennae.

Internal Fertilization: the act of process if initiating biological reproduction by insemination or pollination. The union of male and female gametes to form a zygote.

Karyogamy: the fusion of pronuclei of two cells, as part of syngamy (fertilization) in eukaryotes. It is a critical even in sexual reproduction one of the two major modes of reproduction in fungi. In fungi that lack sexual cycles, it can also be an important source of genetic variation through the formation of somatic diploids.

Larva: a distinct juvenile form many animals undergo before metamorphosis into adults. Animals with indirect development such as insects, amphibians, or cnidarians typically have a larval phase of their life cycle.

Lichen: composite organisms consisting of a fungus and a photosynthetic partner growing together in a symbiotic relationship. The photobiont is usually either a green alga or cyanobacterium.

Longitudinal Muscle: either of the lingual muscles: inferior lingual and superficial lingual

Marine Anoxia: absence of oxygen

Mass Extinction: the extinction of a large number of species within a relatively short period of geological time, thought to be due to factors such as a catastrophic global event or widespread environmental change that occurs too rapidly for most species to adapt. At least five mass extinctions have been identified in the fossil record, coming at or toward the end of the Ordovician, Devonian, Permian, Triassic and Cretaceous periods. The Permian extinction which took place 245 million years ago, is the largest known mass extinction in the Earth's history, resulting in the

extinction of an estimated 90 percent of marine species. In the Cretaceous extinction, 65 million years ago, an estimated 75 percent of species including the dinosaurs, became extinct, possibly as the result of an asteroid colliding with the Earth.

Megasporangium: a structure in certain spore-bearing plants in which the megaspores are formed: corresponds to the ovule in seed plants.

Megaspore: the larger meiospore produced in heterosporous plants, and develops into a female gametophyte.

Metamorphosis: a biological process by which an animal physically develops after birth or hatching, involving a conspicuous and relatively abrupt change in the animals body structure through cell growth and differentiation.

Microsporangium: a sporangium that produces spores that give rise to male gametophytes.

Mucous Glands: glands secreting or producing mucous.

Oviparous: producing young by means of eggs which are hatched after they have been laid by the parent, as in birds.

Ovules: “small egg” in seed plants the ovule is the structure that gives rise to and contains the female reproductive cells.

Pangea: was a supercontinent that existed during the late Paleozoic and early Mesozoic eras, forming approximately 300 million years ago. It began to break apart around 200 million years ago. Broke apart during the Triassic and Jurassic periods, separating into Laurasia and Gondwanaland.

Permian Period: the last geological period in the Paleozoic era. It extended from the end of the Carboniferous period, about 299 million years ago, to the beginning of the Mesozoic era, about 251 million years ago. It was named by the British geologist Roderick Murchison in 1841 after the Perm province in Russia. In some areas continental conditions prevailed, which continued into the following period, the Triassic. These conditions resulted in the deposition of the New Red Sandstone. During the period a number of animal groups became extinct, including the trilobites, tabulate and rugose corals, and blastoids. Amphibians and reptiles continued to be the dominant land animals and gymnosperms replaced ferns, clubmosses and horsetails as the dominant plants.

Plasmogamy: Fusion of the cytoplasm of two or more cells. It precedes union of the nuclei in fertilization and it occurs in heterokaryosis.

Poison Glands: Any of various specialized glands in certain fishes and amphibians

which secrete poisonous mucuslike substances.

Pollen: The mass of grains containing the male gametes of seed plants, which are produced in large numbers in the pollen sacs. The pollen grains of insect-pollinated plants may be spiny or pitted and are usually larger than those of wind-pollinated plants, which are usually smooth and light. The pollen grain represents the male gametophyte generation; it contains two male nuclei: a generative nucleus and a tube nucleus. The wall of the mature pollen grain consists of the tough outer wall (exine) and the more delicate narrower (intine). The latter gives rise to the pollen tube.

Pollen Tube: An outgrowth of a pollen grain, which transports the male gametes to the ovule. It will only grow if the pollen grain is compatible with the female tissue. In angiosperms, the pollen grain is deposited on the stigma and the pollen tube grows down through the style and into the ovule. In some conifers, ex Pinus (pines), the pollen tube penetrates the nucellus but does not develop further until the following year, when the female part of the plant is mature.

Procuticle: the cuticle forms the outer skeleton of arthropods, including insects.

Pupa: The third stage of development in the life cycle of endopterygote insects. During the pupal stage locomotion and feeding cease and metamorphosis from the larva to the adult form takes place. There are three types of pupa. The commonest is the exarate, or free pupa in which the wings and other appendages are visible and movable. In the obtect type the wings are stuck to the body and immovable, as in the chrysalis of a butterfly or moth; and in the co-arctate type an exarate pupa develops within a hard barrel-shaped puparium, as in the housefly and other Diptera.

Reptilia: The class that contains the first entirely terrestrial vertebrates, which can live in dry terrestrial habitats as their skin is covered by a later of horny scales, preventing water loss. They breathe atmospheric oxygen by means of lungs assisted by respiratory movements principally involving the ribs (there is no diaphragm). Reptiles are cold-blooded but behavioral patterns make it possible for them to maintain a fairly even body temperature throughout the day. Fertilization is internal and the majority of reptiles lay eggs on land. These eggs have a porous shell to provide protection from desiccation and allow gas exchange. In some reptiles the eggs are retained within the body of the mother until the young are ready to hatch, thereby greatly reducing juvenile mortality.

Seed: The structure in angiosperms and gymnosperms that develops from the ovule after fertilization. Occasionally seed may develop without fertilization taking place. The seed contains the embryo and nurtritive tissue, either as endosperm or food stored in the cotyledons. Angiosperm seeds are contained within a fruit that develops from the ovary wall. Gymnosperm seeds lack an enclosing fruit and are thus termed naked. The seed is covered by a protective layer, the testa. During development of the testa the seed dries out and enters a resting phase (dormancy)

until conditions are suitable for germination. Annual plants survive the winter or dry season as seeds. The evolution of the see habit enabled plants to colonize the land since seed plants do not depend on water for fertilization unlike the lower plants.

Segmentation: the division of an anima's body (except at the head region) into a number of compartments (segments or metameres) each containing the same organs. Metameric segmentation is most strongly marked in annelid worms (earthworms), in which the muscles, blood vessels, nerves, etc are repeated in each segment. In these animals the segmentation is obvious both externally and internally. It also occurs internally in arthropods and in the embryonic development of all vertebrates, in which it is confined to parts of the muscular, skeletal and nervous systems and does not show externally.

Spermatophore: a protein capsule containing a mass of spermatozoa, transferred during mating in various insects, arthropods, cephalopod molluscs, etc.

Spiracle: A small paired opening that occurs on each side of the head in cartilaginous fish. It is the reduced first gill slit, its small size

Spores: a reproductive cell that can develop into an individual without first fusing with another reproductive cell. Spores are produced by plants, fungi, bacteria, and some protists. A spore may develop into an organism resembling the parent or into another stage in the life cycle, either immediately or after a period of dormancy. In plants showing alternations of generations, spores are formed by the sporophyte generation and give rise to the gametophyte generation. In ferns, the rows of brown reproductive structures on the undersurface of the fronds are spore-producing bodies.

Sporophyte: The generation in the life cycle of a plant that produces spores. The sporophyte is diploid but its spores are haploid. It is either completely or partially dependent on the gametophyte generation in mosses and liverworts, but is the dominant plant in the life cycle of clubmosses, horsetails, ferns and seed plants.

Tagma: A section of the body of an arthropod that is formed by the fusion of mesodermal somites, and has a distinct function and structure. The basic tagmata are the head, thorax, and abdomen but the form of the tagmata (known as tamosis) varies between arthropod groups, each group having it's characteristic tagmosis. For example, many crustaceans have a cephalothorax and abdomen while arachnids have a prosoma and opisthosoma.

Trachea: An air channel in insects and most other terrestrial arthropods. Tracheae occur as ingrowths of the body wall. They open to the exterior by spiracles and branch into finer channels (tracheoles) that terminate in the tissues. Pumping movements of the abdominal muscles cause air to be drawn into and out of the tracheae.

Tracheal System: Series of tubes that carry oxygen to cells in an insects body.

Vessel Elements: A type of cell occurring within the xylem of flowering plants, many of which, end to end form water conducting vessels. Vessel elements are frequently very broad and have side walls thickened by deposits of lignin over most of the surface area. However, the end walls are broken down to provide connections with the cells both above and below them.

Yolk Sac: One of the protective membranes surrounding the embryos of birds, reptiles, and mammals. The embryo derives nourishment from the yolk sac via a system of blood vessels. In birds and reptiles, the yolk sac encloses the yolk; in most mammals a fluid replaces the yolk.

Mesozoic Era:

Amniote Animals: A vertebrate whose embryos are totally enclosed in a fluid-filled sac- the amnion. The evolution of the amnion provided the necessary fluid environment for the developing embryo and therefore allowed animals to breed away from water. Amniotes comprise the reptiles, birds, and mammals.

Anapsid: a reptile having a skull with no temporal openings. The earliest reptiles, the cotylosaurs, were anapsids, as are modern turtles. Anapsids probably gave rise to the diapsids and synapsids.

Anther: the upper two lobed part of a plant stamen, usually yellow in colour. Each lobe contains two pollen sacs within which are numerous pollen grains, which are released when the anther ruptures.

Bird Hipped Dinosaurs: derive their name from the shape of their pelvis, which resembles that of modern birds, whose pubis points to the rear of the animal.

Carpel: the female reproductive organ of a flower. Typically it consists of a stigma, style and ovary. It is thought to have evolved by the fusion of the two edges of a flattened megasporophyll. Each flower may have one carpel (monocarpellary) or many (polycarpellary), either free (apocarpous) or fused together (syncarpous).

Cephalopods: The most advanced class of molluscs, containing the squids, cuttlefishes, octopuses and the extinct ammonites. Cephalopods have a highly concentrated central nervous system within a protective cartilaginous case. The eye has a well developed retina and is comparable to that of vertebrates. All cephalopods are predacious carnivores capable of swimming by jet propulsion; they have highly mobile tentacles for catching and holding prey.

Co-Evolution: The influence of closely associated species on each other in their evolution.

Cretaceous: The final geological period of the Mesozoic era. It extended from about 144 million years ago, following the Jurassic to about 65 million years ago when it was succeeded by the Palaeogene Period. The name of the period is derived from creta (latin: chalk) and the cretaceous was characterized by the deposition of large amounts of chalk in western Europe. The Cretaceous was the time of greatest flooding in the Mesozoic. Angiosperm plants made their first appearance on land and in the early Cretaceous Mesozoic reptiles reached their peak. At the end of the period there was a mass extinction of the dinosaurs, flying reptiles, and ammonites, the cause of which may be related to environmental changes resulting from collisions of the earth with large meteorites.

Diapsids: a reptile of a large group characterized by the presence of two temporal openings in the skull, including the lizards, snakes, crocodiles, dinosaurs and pterosaurs.

Double Fertilization: A process unique to flowering plants, in which two male gamete nuclei, which have travelled down the pollen tube, separately fuse with different female nuclei in the embryo sac. The first male nucleus fuses with the egg cell to form the zygote; the second male nucleus fuses with the two polar nuclei to form a triploid nucleus that develops into the endosperm.

End Triassic Extinction: global extinction event occurring at the end of the Triassic period that resulted in the demise of some 76 percent of all marine and terrestrial species and about 20 percent of all taxonomic families. It is thought that the end-Triassic extinction was the key moment that allowed the dinosaurs to become the dominant land animals on Earth. The event ranks fourth in severity of the five major extinction episodes that span geologic time.

Extant: a term commonly used in biology to refer to taxa, such as species, genera and families, that are still in existence, meaning still alive as opposed to extinct.

Extinct: in biology extinction is the end of an organism or a group of organisms, normally a species.

Fruit: The structure formed from the ovary of a flower, usually after the ovules have been fertilized. It consists of the fruit wall, enclosing the seed(s). Other parts of the flower, such as the receptacle, may develop and contribute to the structure, resulting in a false fruit. The fruit may retain the seeds and be dispersed whole (an indehiscent fruit) or it may open (dehisce) to release the seeds. Fruits are divided into two main groups depending on whether the ovary wall remains dry or becomes fleshy (succulent). Succulent fruits are generally dispersed by animals and dry fruits by wind, water or by some mechanical means.

Jurassic: The second geological period of the Mesozoic era. It followed the Triassic, which ended about 200 million years ago, and extended until the beginning of the Cretaceous period, about 145 million years ago. It was named in 1829 by A.

Brongniart after the Jura Mountains on the borders of France and Switzerland. Jurassic rocks include clays and limestones in which fossil flora and fauna are abundant. Plants included ferns, cycads, ginkgos, rushes and conifers. Important invertebrates included ammonites (on which the Jurassic is zoned), corals, brachiopods, bivalves and echinoids. Reptiles dominated the vertebrates and the first flying reptiles- the pterosaurs- appeared. The first primitive bird, Archaeopteryx also made its appearance.

K/T Boundary: The collision of a giant meteorite with the earth 65 million years ago that caused catastrophic changes to the earth's climate and environment and a mass extinction of species, including the dinosaurs. This hypothesis was advanced in 1980 by the US physicist Luis Walter Alvarez (1911–88) and his geologist son Walter Jr, based on the unusually high concentration of the element iridium in a thin layer of clay deposited at the end of the Cretaceous (see iridium anomaly). This clay marks the boundary between the Cretaceous period and the more recent Palaeogene (the so-called **K-T boundary**). Subsequently, geologists discovered a possible impact crater, roughly 160 km in diameter, along the coast of eastern Mexico, and other evidence has tended to support the hypothesis. Such a collision would have produced a massive tidal wave and fireball and sent a vast cloud of rock and other debris into the atmosphere. The resulting upheaval in the climate is estimated to have caused the extinction of some 75% of all species.

Nectar: A sweet liquid secreted by flowers of various plants, consumed by pollinators, such as hummingbirds and insects and gathered by bees for making honey.

Ornithischia: A dinosaur of the order Ornithischia, having a pelvic structure similar to that of birds.

Oviparous: producing young by means of eggs which are hatched after they have been laid by the parent, as in birds.

Plesiosaurs: a large fossil marine reptile of the Mesozoic era, with a broad flat body, large paddle like limbs, and typically a long flexible neck and small head.

Pollination: the process by which pollen is transferred in the reproduction of plants, thereby anabling fertilization and sexual reproduction.

Pterosaurs: a fossil warm blooded flying reptile of the Jurassic and Cretaceous periods, with membranous wings supported by a greatly lengthened fourth finger, and probably covered with fur.

Saurischia: any herbivorous or carnivorous dinosaur of the order Saurischia having a three pronged pelvis resembling that of a crocodile.

Sauropods: a very large quadrupedal herbivorous dinosaur with a long neck and

tail, small head and massive limbs.

Stamen: One of the male reproductive parts of a flower. It consists of an upper fertile part (anther) on a thin sterile stalk (the filament).

Syanpsids: synonymous with theropsids, are a group of animals that includes mammals and every animal more closely related to mammals than to other living amniotes.

Temporal Fenestra: anatomical features of the skulls of several types of amniotes, characterized by bilaterally symmetrical holes (fenestrae) in the temporal bone.

Theropods: suborder of bipedal saurichian dinosaurs and a clade consisting of that suborder and its descendants. A carnivorous dinosaur whose members were typically bipedal and ranged from small and delicately built to very large.

Vertebrate: any one of a large group of animals comprising all those members of the subphylum Craniata that have backbones. Vertebrates include the fishes, amphibians, reptiles, birds and mammals.

Cenozoic Era:

Alpha Keratin: a class of fibrous proteins or scleroproteins that represents the principal constituents of epidermis, hair, nails, horny tissues, and the organic matrix of tooth enamel.

Apocrine Sweat Gland: any of numerous glands found primarily in the skin of the armpit, pubic region, and areolae of the breasts that produce a secretion that is more viscous than that formed by the eccrine glands. Secretions from these glands occur most frequently during periods of emotional stress or sexual excitement.

Barb: (in zoology) any one of the stiff filaments forming a row on each side of the longitudinal shaft of a feather. Together the bards form the expanded part of the feather. (in botany) a hooked hair.

Barbule: any of the minute filaments forming a row on each side of the barb of a feather. In a contour feather adjacent barbules interlock by means of hooks (barbicels) and grooves, forming a firm vane. Down feathers have no barbicels.

Deciduous Teeth: the first two sets of teeth of a mammal. These teeth are smaller than those that replace them (the permanent teeth) and fewer in number, since there are no deciduous molars.

Eccrine Sweat Gland: certain sweat glands, distributed over the entire body, that secrete a type of sweat important for regulating body heat.

Endothermy: an animal that can generate and maintain heat within its body

independently of the environmental temperature. Mammals and birds are endotherms; they are often described as being warm blooded.

Glandular Skin: having glands

Great Apes: a large ape of a family closely related to humans, including the gorilla, orang-utan, and chimpanzees, but excluding the gibbons; an anthropoid ape.

Heterodont Dentition: describing animals that possess teeth of more than one type (ie. incisors, canine teeth, premolars and molars), each with a particular function. Most mammals are heterodont.

Mammary Gland: the milk producing organs (possibly modified sweat glands) of female mammals, which provide food for the young. Their number (2 to 20) and position (chest or abdomen) vary according to the species. In most mammals, the gland openings project as a nipple or teat. Nipples have a number of milk duct openings; teats have one duct leading from a storage cavity.

Oviparous: producing young by means of eggs which are hatched after they have been laid by the parent, as in birds.

Parental Care: any behavior pattern in which a parent invests time or energy in feeding and protecting its offspring. Parental care is a form of altruism since this type of behavior involves increasing the fitness of the offspring at the expense of the parents. The degree of parental care differs widely. For example, most species of fish show little or no parental care while humans and many other mammals care for their offspring until they reach adolescence.

Placenta: 1. The organ in mammals and other viviparous animals by means of which the embryo is attached to the wall of the uterus. It is composed of embryonic and maternal tissues: extensions of the chorion and allantois grow into the uterine wall so that materials (oxygen, nutrients) can pass between the blood of the embryo and its mother (there is however, no direct connection between the maternal and embryonic blood). The placenta is eventually expelled as part of the afterbirth.

Pneumatized Bone: a bone that is hollow or contains many air cells, such as the mastoid process of the temporal bone.

Sebaceous Gland: a small gland occurring in mammalian skin. Its duct opens into a hair follicle, through which it discharges sebum onto the skin surface.

Sternal Keel: an extension of the sternum which runs axially along the midline of the sternum and extends outwards, perpendicular to the plane of the ribs. The keel provides an anchor to which a birds wing muscles attach, thereby providing adequate leverage or flight.

Vivaparous: a form of reproduction in animals in which the developing embryo obtains its nourishment directly from the mother via a placenta or by other means. Viviparity occurs in some insects and other arthropods, in certain fishes, amphibians, and reptiles and in the majority of mammals.