Biology Pearson Workbook Chapter 34

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Biology Pearson Workbook Chapter 34

Chapter 34 Vertebrates - Chapter 34 Vertebrates by Ms. Barker's Chemistry & Biology Channel 3,846 views 3 years ago 24 minutes
Chapter 34 The Origin and Evolution of Vertebrates
Half a Billion Years of Backbones • Early in the Cambrian period, about 530 million years ago, an astonishing variety of invertebrate animals inhabited Earth's oceans One type of animal gave rise to vertebrates, one of the most successful groups of animals • The animals called vertebrates get their name from vertebrae, the series of bones that make up the backbone One lineage of vertebrates colonized land 365 million years ago There are about 52,000 species of vertebrates, including the largest organisms ever to live on the Earth • Vertebrates have great disparity, a wide range of differences within the group
Notochord • The notochord is a longitudinal, flexible rod between the digestive tube and nerve cord • It provides skeletal support throughout most of the length of a chordate • In most vertebrates, a more complex, jointed skeleton develops, and the adult retains only remnants of the embryonic notochord Dorsal, Hollow Nerve Cord . The nerve cord of a chordate embryo develops from a plate of ectoderm that rolls into a tube dorsal to the notochord • The nerve cord develops into the central nervous system: the brain and the spinal cord
Pharyngeal Slits or Clefts • In most chordates, grooves in the pharynx called pharyngeal clefts develop into slits that open to the outside of the body Functions of pharyngeal slits - Suspension-feeding structures in many invertebrate
Tunicates • Tunicates (Urochordata) are more closely related to other chordates than are lancelets • Tunicates most resemble chordates during their larval stage, which may last only a few minutes • As an adult, a tunicate draws in water through an incurrent siphon, filtering food particles • When attacked, tunicates, or sea squirts,' shoot water through their excurrent siphon • Tunicates are highly

derived and have fewer Hox genes than other vertebrates
Early Chordate Evolution . Ancestral chordates may have resembled lancelets • The same Hox genes that organize the vertebrate brain are expressed in the lancelet's simple nerve cord tip . Genome sequencing suggests that - Genes associated with the heart and thyroid are
Concept 34.2: Craniates are chordates that have a head The origin of a head enabled chordates to coordinate more complex movement and feeding behaviors • Craniates share some characteristics: a skull, brain, eyes, and other sensory organs
Derived Characters of Craniates • Craniates have two clusters of Hox genes, lancelets and tunicates have only one cluster • One feature unique to craniates is the neural crest, a collection of cells near the dorsal margins of the closing neural tube in an embryo Neural crest cells give rise to a variety of structures including some of the bones and cartilage of the skull In aquatic craniates the pharyngeal clefts evolved into gill slits • Craniates have a higher metabolism and are more muscular than tunicates and lancelets Craniates have a heart with at least two chambers, red blood cells with hemoglobin, and kidneys
The Origin of Craniates • Fossils from the Cambrian explosion document the transition to craniates The most primitive of the fossils are those of the 3- cm-long Haikouella . Haikouella had a well-formed brain, eyes, and muscular segments, but not a skull . In other Cambrian rocks, paleontologists have found fossils of even more advanced chordates, such as Myllokunmingia Myllokunmingia had parts of a skull and was a true craniate
Hagfishes . The most basal group of craniales is Myxini, the hagfishes Hagfishes have a cartilaginous skull and axial rod of cartilage derived from the notochord, but lack jaws and vertebrae They have a small brain, eyes, ears, and tooth-like formations Hagfishes are marine; most are bottom-dwelling scavengers
Concept 34.3: Vertebrates are craniates that have a backbone During the Cambrian period, a lineage of craniates evolved into vertebrates • Vertebrates became more efficient at capturing food and avoiding being eaten
Derived Characters of Vertebrates • Vertebrates underwent a second gene duplication involving the Dix family of transcription factors • Vertebrates have the following derived characters - Vertebrae enclosing a spinal cord - An elaborate skull - Fin rays, in the aquatic forms
Lampreys • Lampreys (Petromyzontida) represent the oldest living lineage of vertebrates They are jawless vertebrates that feed by clamping their mouth onto a live fish They inhabit various marine and freshwater habitats • They have cartilaginous segments surrounding the notochord and arching partly over the nerve cord
Fossils of Early Vertebrates • Conodonts were the first vertebrates with mineralized skeletal elements in their mouth and pharynx • Their fossilized dental elements are common in the fossil record • Other armored, jawless vertebrates had defensive plates of bone on their skin
Concept 34.4: Gnathostomes are vertebrates that have jaws Today, jawed vertebrates, or gnathostomes, outnumber jawless vertebrates • They include sharks and their relatives, ray-finned fishes, lobe-finned fishes, amphibians, reptiles (including birds). and mammals • Their jaws might have evolved from skeletal supports of the pharyngeal sits Other common characters include: - Genome duplication, including duplication of Hox genes - An enlarged forebrain associated with enhanced smell and
Sharks • Have a streamlined body and are swift swimmers • The largest ones are suspension foeders, but most are camivores Have a short digestive tract with a ridge called the spiral valve to increase the digestive surface area . detect electrical fields from nearby animals Shark eggs are fertilized internally but embryos can develop in different ways - Oviparous: Eggs hatch outside the mother's body - Ovoviviparous: The embryo develops within the uterus and is - Viviparous: The embryo develops within the uterus and is
Ray-Finned Fishes and Lobe-Fins The vast majority of vertebrates belong to a clade of gnathostomes called Osteichthyes • Nearly all living osteichthyans have a bony endoskeleton • Include the bony fish and tetrapods Aquatic osteichthyans are the vertebrates we informally call fishes Most fishes breathe by drawing water over gills protected by an operculum Fishes control their buayancy with an air sac known as a swim bladder Fishes have a lateral line system Most species are oviparous, but some have internal fertization and birthing
Ray-Finned Fishes Actinopterygii, the ray-finned fishes, include nearly all the familiar aquatic osteichthyans Ray-finned fishes originated during the Silurian period (444 to 416 million years ago) The fins, supported mainly by long, flexible rays, are modified for maneuvering, defense, and other functions
Lobe-Fins • The lobe-fins (Sarcopterygii) have muscular pelvic and pectoral fins • Lobe-fins also

originated in the Silurian period Three lineages survive and include coelacanths, lungfishes, and tetrapods Coelacanths were thought to have become extinct 75 million years ago, but a living coelacanth was caught off the coast of South Africa in 1938
Concept 34.5: Tetrapods are gnathostomes that have limbs One of the most significant events in vertebrate history was when the fins of some lobe-fins evolved into the limbs and feet of tetrapods Tetrapods have some specific adaptations (derived characters) - Four limbs, and feet with digits - A neck, which allows separate movement of the head - Fusion of the pelvic girdle to the backbone - The absence of gils (except some aquatic species) - Ears for detecting airborne sounds
Amphibians • Amphibians (class Amphibia) are represented by about 6,150 species • Order Urodela includes salamanders, which have tails Order Anura includes frogs and toads, which lack tails • Order Apoda includes caecilians, which are legless and resemble worms Amphibian means both ways of life, referring to the metamorphosis of an aquatic larva into a terrestrial adult . Most amphibians have moist skin that complements the lungs in gas exchange
Concept 34.6: Amniotes are tetrapods that have a terrestrially adapted egg Amniotes are a group of tetrapods whose living members are the reptiles, including birds, and mammals
Derived Characters of Amniotes • Amniotes are named for the major derived character of the clade, the amniotic egg, which contains membranes that protect the embryo . The extraembryonic membranes are the amnion, chorion, yolk sac, and allantois • The amniotic eggs of most reptiles and some mammals have a shell • Amniotes have other terrestrial adaptations, such as relatively impermeable skin and the ability to use the rib cage to ventilate the lungs
Early Amniotes • Living amphibians and amniotes split from a common ancestor about 350 million years ago • Early amniotes were more tolerant of dry conditions than early tetrapods • The earliest amniotes were small predators with sharp teeth and long jaws
Reptiles • The reptile clade includes the tuataras, lizards snakes, turtles, crocodilians, birds, and some extinct groups Reptiles have scales that create a waterproof barrier . Most reptiles lay shelled eggs on land Most reptiles are ectothermic, absorbing external heat as the main source of body heat • Birds are endothermic, capable of keeping the body warm through metabolism
The Origin and Evolutionary Radiation of Reptiles
Lepidosaurs • One surviving lineage of lepidosaurs is represented by two species of lizard-like reptiles called tuataras • The other major living lineage of lepidosaurs consists of the squamates, the lizards and snakes • Lizards are the most numerous and diverse reptiles, apart from birds • Snakes are legless lepidosaurs that evolved from lizards • Snakes are carnivorous; some are also venomous
Birds • Birds are archosaurs, but almost every feature of their reptilian anatomy has undergone modification in their adaptation to flight Derived Characters
The Origin of Birds • Birds probably descended from small theropods, a group of carnivorous dinosaurs Early feathers might have evolved for insulation, camouflage, or courtship display Early feathers might have helped dinosaurs
Living Birds Living birds belong to the clade Neomnithes . Several groups of birds are flightless - The ratites, order Struthioniformes - Penguins, order Sphenisciformes - Certain species of rails, ducks, and pigeons The demands of flight have rendered the general body form of many flying birds similar to one another
Concept 34.7: Mammals are amniotes that have hair and produce milk Mammals, class Mammalia, are represented by more than 5,300 species Mammals have the following derived characters 1 Mammary glands, which produce mik 2 Hair 3 A high metabolic rate, due to endothermy 4 A larger brain than other vertebrates of equivalent size 5 Differentiated teeth
Early Evolution of Mammals • Mammals evolved from synapsids . Two bones that formerly made up the jaw joint were incorporated into the mammalian middle ear . By the early Cretaceous, the three living lineages of mammals emerged: monotremes, marsupials, and eutherians • Mammals did not undergo a significant adaptive radiation until after the Cretaceous
Marsupials • Include opossums, kangaroos, and koalas • The embryo develops within a placenta in the mother's uterus • Is bom very early in its development • It completes its embryonic development while nursing in a maternal pouch called a marsupium Long-nosed bandicoot • In some species, such as the bandicoot, the marsupium opens to the rear of the mother's body In Australia, convergent evolution has resulted in a diversity of marsupials that resemble the eutherians in other parts of the world
Eutherians (Placental Mammals) . Compared with marsupials, eutherians have a more complex placenta • Young eutherians complete their embryonic development within a uterus, joined to the mother by the placenta . Molecular and morphological data give conflicting dates on the diversification of eutherians

Primates • The mammalian order Primates includes lemurs, tarsiers, monkeys, and apes • Humans are members of the ape group • Derived characters include: 1 have hands and feet adapted for grasping 2 flat nails 3 a large brain and short jaws 4 forward-looking eyes close together on the face Concept 34.8: Humans are mammals that have a large brain and bipedal locomotion The species Homo sapiens is about 200,000 years old, which is very young, considering that life has existed on Earth for at least 3.5 bilion years • A number of derived characters distinguish humans from other apes 1 Upright posture and bipedal locomotion 2 Larger brains capable of language, symbolic thought, artistic expression, the manufacture & use of complex tools 3 Reduced jawbones and jaw muscles 4 Shorter digestive tract The human and chimpanzee genomes are 99% identical Changes in regulatory genes can have large effects

Misconceptions about Hominins Misconception 1: Early hominins were chimpanzees - Correction: Hominins and chimpanzees shared a

Neanderthals Neanderthals, Homo neanderthalensis, lived in Europe and the Near East from 350,000 to 28,000 years ago They were thick-boned with a larger brain, they buried their dead, and they made hunting tools • Debate is ongoing about the extent to which genetic material was exchanged between neanderthals and Homo sapiens

Homo Sapiens - Appeared in Africa by 195,000 years ago All living humans are descended from these African ancestors The oldest fossils outside Africa date back about 115,000 years and are from the Middle East Humans first arrived in the New World sometime before 15,000 years ago In 2004, 18,000-year-old fossils were found in Indonesia, and a new small hominin was named: Homo floresiensis . Homo sapiens were the first group to show evidence of symbolic and sophisticated thought In 2002, a 77,000-year-old artistic carving was found in South Africa

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