Classification of living things pdf

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From the time of Plato and Aristotle, it was believed that all life could be organized from most primitive to most advanced along a "Great Chain of Being." The most primitive forms of life were placed at the bottom of the hierarchy, while humans resided on the top (royalty above commoners, men above men of other races--the vanity of the aristocratic white men who developed the system is clearly visible!), closest to God. We now know that a true classification system for the diversity of life is more like a branching tree than a stairway to perfection. Plants are not inferior to animals, for example, but have simply taken a different strategy towards survival. All organisms alive today are successfully adapted to their respective environments, since they have stood the test of time. In fact, there are even some extinct forms, like the trilobites and the dinosaurs, that long! You may occasionally hear biologists refer to "primitive" and "advanced" forms of life, but this terminology conveys a value judgment and is, therefore, to be avoided. Better to speak of ancestral (little changed from earlier forms) and derived (more changed from earlier forms) and derived (more changed) traits or species. remained virtually unchanged for hundreds of millions of years? Sharks are "primitive" cartilagenous fishes, but they feast on a diet of more "advanced" bony fish. Better not to think of life as a hierarchy of superior and inferior forms but, rather, as a branching bush of great diversity, all derived from the same root. The Linnean system is still used to categorize living things, but we now accept that the levels of organization from Kingdom down to species are somewhat arbitrary. Physical comparisons are often effective at identifying relationships between species, but they can sometimes be misleading. body form because they swim through the water. Dolphins and dogs, at first glance, don't appear to be very closely related, but they are both mammals and are therefore much closer relatives than dolphins and sharks. Adding what we know from DNA comparisons helps us to check our conclusions made from physical characteristics. Physically, humans are most similar to the great apes; the gorillas, chimpanzees and oragutans. We know from DNA analysis, however, that our closest living non-human relatives are the chimpanzees; approximately 95% of our DNA is identical to theirs. So how many major divisions, or kingdoms, of living things are there? In elementary school, we learned about the differences between the Plants, which are green and make their own food, and the Animals, which move around and ingest their food. The Fungi, quite distinct from the plants, gain nutrition by absorption, so we have a third kingdom. Then, to take microorganisms into account, two more kingdoms, the Protists (the complex unicellular forms) and Monerans (the primitive single celled forms) are added. The five kingdom system of classification. While this system of organization is reasonable, it contains a bias. In reality, the plants, animals, fungi, and protists are all more similar to each other than any are to the monerans, so one could argue that a better division is between the simper Prokaryotes (the Monerans) and the more complex Eukaryotes (which are then subdivided into Protists, Fungi, Plants, and Animals). That sounded good until the Archaebacteria were discovered, and it turned out that they are as distinct from the rest of the Prokaryotes as the Prokaryotes are from the Eukaryotes! Thus, we end up with a three kingdom system, though, as you can see below, it gets even messier: The Archebacteria (blue), the Eubacteria (green), and the Eukaryota (red). And then there are the viruses which, depending on your definition, may not even be considered living; at least not on their own. While it may seem odd to us that we are grouped in the same kingdom of living things, not just with our furry friends but, with mushrooms, algae, earthworms, and slime molds, it just tells you how much more different the members of the sectremely bizarre life forms of the sector bizarre life forms of th water. It is possible that these are the most ancient of organisms and that they remain little changed from the early days of life on earth. The three kingdom system of classifying organisms See also: Taxonomic rank Part of a series on Evolutionary biologyDarwin's finches by John Gould Index Introduction Main Outline Glossary Evidence History Processes and outcomes Population Divergence Parallel evolution Extinction Natural history Origin of life Common descent History of life Timeline of evolution Human evolution Phylogeny Biodiversity Biogeography Classification Evolutionary taxonomy Cladistics Transitional fossil Extinction event History of evolutionary taxonomy Cladistics Transitional fossil Extinction Evolution Evolution Evolution Evolutionary taxonomy Cladistics Transitional fossil Extinction event History of evolutionary taxonomy Cladistics Transitional fossil Extinction Evolutionary taxonomy Cladistics Transitional fossil Extinction Evolutionary taxonomy Cladistics Transitional fossil Extinction Evolution Evolution Evolution Evolution Evolution Evolution Evolution Evolutionary taxonomy Cladistics Transitional fossil Extinction Evolution E research History of speciation History of paleontology (timeline) Fields and applications of evolutionary ethics Evolutionary game theory Evolutionary linguistics Evolutionary medicine Evolutionary physiology Systematics Universal Darwinism Social implications Evolution as fact and theory Social effects Creation-evolution controversy Theistic evolution Objections to evolution Level of support Evolutionary biology portal Category Related topicsvte In biology, taxonomy (from Ancient Greek τάξις (taxis) 'arrangement', and -νομία (-nomia) 'method') is the scientific study of naming, defining (circumscribing) and classifying groups of biological organisms based on shared characteristics. Organisms are grouped into taxa (singular: taxon) and these groups of a given rank, thus creating a taxonomic hierarchy. The principal ranks in modern use are domain, kingdom, phylum (division is sometimes used in botany in place of phylum), class, order, family, genus, and species. The Swedish botanist Carl Linnaeus is regarded as the founder of the current system known as Linnaean taxonomy for categorizing organisms and binomial nomenclature for naming organisms. With advances in the theory, data and analytical technology of biological systematics, the Linnaean system has transformed into a system of modern biological classification intended to reflect the evolutionary relationships among organisms, both living and extinct. Definition of taxonomy varies from source to source, but the core of the discipline remains: the conception, naming and classification of groups of organisms.[1] As points of reference, recent definitions of taxonomy are presented below: Theory and practice of groups, and giving those groups names, thus producing a classification.[2] A field of science (and major component of systematics) that encompasses description, identification, in biology the arrangement of organisms, including study of means of formation of species, etc."[5] "The analysis of an organisms into a classification[4] "The science of classification[4] "The science of classification as applied to living organisms, including study of means of formation of species, etc."[5] "The analysis of an organisms into a classification.] classification [6] "Systematics studies phylogeny to provide a pattern that can be translated into the classification and names of the more inclusive field of taxonomy" (listed as a desirable but unusual definition)[7] The varied definition [7] The varied definitions either place taxonomy as a sub-area of systematics (definition 2), invert that relationship (definition 6), or appear to consider the two terms synonymous. There is some disagreement as to whether biological nomenclature is considered a part of taxonomy.[8] For example, definition 6 is paired with the following defini study of the identification, taxonomy, and nomenclature of organisms, including the classification of living things with regard to their natural relationships and the study of variation and the evolution of taxa". In 1970 Michener et al. defined "systematic biology" and "taxonomy" (terms that are often confused and used interchangeably) in relationship to one another as follows:[9] Systematic biology (hereafter called simply systematics) is the field that (a) provides scientific names for organisms, (b) describes them, (c) preserves collections of them, (d) provides scientification, and data on their distributions, (e) investigates their evolutionary histories, and (f) considers their environmental adaptations. This is a field with a long history that in recent years has experienced a notable renaissance, principally with respect to theoretical content. Part of the theoretical material has to do with evolutionary areas (topics e and f above), the rest relates especially to the problem of classification. Taxonomy is that part of Systematics concerned with topics (a) to (d) above. A whole set of terms including taxonomy, systematics, biosystematics, biosyst [1][10] The broadest meaning of "taxonomy" is used here. The term itself was introduced in 1813 by de Candolle, in his Théorie élémentaire de la botanique.[11] John Lindley provided an early definition of systematics in 1830, although he wrote of "systematic botany" rather than using the term "systematics".[12] Europeans tend to use the terms "systematics" and "biosystematics" for the study of biodiversity as a whole, whereas North Americans tend to use "taxonomy, is more specifically the identification, description, and naming (i.e. nomenclature) of organisms, [14] while "classification" focuses on placing organisms within hierarchical groups that show their relationships to other organisms. Monograph and
taxonomic revision or taxonomic morphological, anatomical, palynological, biochemical and genetic. A monograph or complete revision is a revision that is comprehensive for a taxon for the entire world. Other (partial) revisions may be restricted in the sense that they may only use some of the available character sets or have a limited spatial scope. A revision results in a conformation of or new insights in the relationships between the subtaxa, or the merger of previous subtaxa, or the merger of previous subtaxa, are the taxonomic characters are taxo attributes that can be used to provide the evidence from which relationships (the phylogeny) between taxa are inferred.[16] Kinds of taxonomic characters General external morphology (anatomy) Embryology Karyology and other cytological factors Physiological characters Metabolic factors Body secretions Genic sterility factors Molecular characters Immunological distance Electrophoretic differences Amino acid sequences of proteins DNA hybridization DNA and RNA sequences Restriction endonuclease analyses Other molecular differences Behavioral characters Courtship and other ethological isolating mechanisms Other behavior patterns Ecological characters Habit and habitats Food Seasonal variations Parasites and hosts Geographic distribution patterns Sympatric-allopatric relationship of populations Alpha and beta taxonomy Not to be confused with Alpha diversity. The term "alpha taxonomy" is primarily used today to refer to the discipline of finding, describing, and naming taxa, particularly species.[18] In earlier literature, the term had a different meaning, referring to morphological taxonomy, and the products of research through the end of the 19th century.[19] William Bertram Turrill introduced the term "alpha taxonomy in a series of papers published in 1935 and 1937 in which he discussed the philosophy and possible future directions of the discipline of taxonomists to consider their problems from wider viewpoints, to investigate the possibilities of closer co-operation with their cytological, ecological and genetics colleagues and to acknowledge that some revision or expansion, perhaps of a drastic nature, of their aims and methods, may be desirable ... Turrill (1935) has suggested that while accepting the older invaluable taxonomy built upon as wide a basis of morphological and physiological facts as possible, and one in which "place is found for all observational and experimental data relating, even if indirectly, to the constitution, subdivision, origin, and behaviour of species and other taxonomic groups". Ideals can, it may be said, never be completely realized. They have, however, a great value of acting as permanent stimulants, and if we have some, even vague, ideal of an "omega" taxonomy we may progress a little way down the Greek alphabet. Some of us please ourselves by thinking we are now groping in a "beta" taxonomy.[20] Turrill thus explicitly excludes from alpha taxonomy various areas of study that he includes within taxonomy as a whole, such as ecology, physiology, genetics, and cytology. He further excludes phylogenetic reconstruction from alpha taxonomy.[21] Later authors have used the term in a different sense, to mean the delimitation of species (not subspecies or taxa of other ranks), using whatever investigative techniques are available, and including from alpha taxonomy. sophisticated computational or laboratory techniques.[22][18] Thus, Ernst Mayr in 1968 defined "beta taxonomy" as the classification of ranks higher than species.[23]An understanding of the biological meaning of variation and of the evolutionary origin of groups of related species is even more important for the second stage of taxonomic activity, the sorting of species into groups of relatives ("taxa") and their arrangement in a hierarchy of higher categories. This activity is what the term classification denotes; it is also referred to as "beta taxonomy". Microtaxonomy Main article: Species problem How species should be defined in a particular group of organisms gives rise to practical and theoretical problems that are referred to as the species problem. The scientific work of deciding how to define species has been called microtaxonomy.[24][25][18][unreliable source?] By extension, macrotaxonomy is the study of groups at the higher taxonomic ranks subgenus and above.[18] History While some descriptions of taxonomic history attempt to date taxonomy to ancient civilizations, a truly scientific attempt to classify organisms did not occur until the 18th century. Early taxonomy was based on arbitrary criteria, the so-called "artificial systems", including Linnaeus's system of sexual classification for plants (Linnaeus's 1735 classification of the characteristics of taxa, referred to as "natural systems", such as those of de Jussieu (1789), de Candolle (1813) and Bentham and Hooker (1862–1863). These classifications described empirical patterns and were pre-evolutionary in thinking. The publication of Charles Darwin's On the Origin of Species (1859) led to a new explanation for classifications, based on evolutionary relationships. This was the concept of phyletic systems, from 1883 onwards. This approach was typified by those of Eichler (1886–1892). The advent of cladistic methodology in the 1970s led to classifications based on the sole criterion of monophyly, supported by the presence of synapomorphies. Since then, the evidentiary basis has been expanded with data from molecular genetics that for the most part complements traditional morphology. [26] [page needed] [27] [page needed] [27] [page needed] [28] Distinguishing poisonous plants from edible plants is integral to the survival of human communities. Medicinal plant illustrations show up in Egyptian wall paintings from c. 1500 BC, indicating that the uses of different species were understood and that a basic taxonomy was in place. [29] Ancient times Further information: Aristotle's biology § Classification Description of rare animals (写生珍禽图), by Song dynasty painter Huang Quan (903–965) Organisms were first classified beings by their parts, or in modern terms attributes, such as having live birth, having four legs, laying eggs, having blood, or being warm-bodied.[33] He divided all living things into two groups: plants and animals.[31] Some of his groups of animals, such as Anhaima (animals with blood, roughly the vertebrates), as well as groups like the sharks and cetaceans, are still commonly used today.[34] His student Theophrastus (Greece, 370-285 BC) carried on this tradition, mentioning some 500 plants and their uses in his Historia Plantarum. Again, several plant groups currently still recognized can be traced back to Theophrastus, such as Cornus, Crocus, and Narcissus.[31] Medieval Taxonomy in the Middle Ages was largely based on the Aristotelian system,[33] with additions concerning the philosophical and existential order of creatures. This included concepts such as the great chain of being in the Western scholastic tradition,[33] again deriving ultimately from Aristotle. The Aristotelian system did not classify plants or fungi, due to the lack of microscopes at the time,[32] as his ideas were based on arranging the complete world in a single continuum, as per the scala naturae (the Natural Ladder).[31] This, as well, was taken into consideration in the great chain of being.[31] Advances were made by scholars such as Procopius, Timotheos of Gaza, Demetrios Pepagomenos, and Thomas Aquinas. Medieval thinkers used abstract philosophical and logical categorizations more suited to abstract philosophy than to pragmatic taxonomy.[31] Renaissance and early modern During the Renaissance and early modern During the Renaissance and the Age of Enlightenment, categorizing organisms became more prevalent,[31] and taxonomic works became ambitious enough to replace the ancient texts. This is sometimes credited to the development of sophisticated optical lenses, which allowed the morphology of organisms to be studied in much greater detail. One of the earliest authors to take advantage of this leap in technology was the Italian physician Andrea Cesalpino (1519–1603), who has been called "the first taxonomist".[35] His magnum opus De Plantis came out in 1583, and described more than 1500 plant species.[36][37] Two large plant families that he first recognized are still in use today: the Asteraceae and Brassicaceae.[38] Then in the 17th century John Ray (England, 1627–1705) wrote many important taxonomic works.[32] Arguably his greatest accomplishment was Methodus Plantarum Nova (1682),[39] in which he published details of over 18,000 plant species. At the time, his classifications were perhaps the most complex yet produced by any taxonomist, as he based his taxa on many combined characters. The next major taxonomic works were produced by Joseph Pitton de Tournefort (France, 1656–1708).[40] His work from 1700, Institutiones Rei Herbariae, included more than 9000 species in 698 genera, which directly influenced Linnaeus, as it was the text he used as a young student. [29] Linnaean era Main article: Linnaean taxonomy Title page of Systema Naturae, Leiden, 1735 The Swedish botanist Carl Linnaeus (1707–1778) [33] ushered in a new era of taxonomy. With his major works Systema Naturae 1st Edition in 1735,[41] Species Plantarum in 1753,[42] and Systema Naturae 10th Edition,[43] he revolutionized modern taxonomy. His works implemented a standardized binomial literature. He not only introduced the standard of class, order, genus, and species, but also made it possible to identify plants and animals from his book, by using the same way today as it was in the 18th century. [44] Currently, plant and animal taxonomists regard Linnaeus' work as the "starting point" for valid names (at 1753 and 1758 respectively).[45] Names published before these dates are referred to as "pre-Linnaean", and not considered valid (with the exception of spiders
published in Svenska Spindlar[46]). Even taxonomic names published by Linnaeus himself before these dates are considered pre-Linnaean.[29] Modern system of classification Main articles: Evolutionary taxonomy and Phylogenetic nomenclature Evolutionary taxonomy The same relationship, expressed as a cladogram typical for cladistics A pattern of groups nested within groups was specified by Linnaeus' classifications of plants and animals, and these patterns began to be represented as dendrograms of the animal and plant kingdoms toward the end of the 18th century, well before Charles Darwin's On the Origin of Species was published.[32] The pattern of the "Natural System" did not entail a generating process, such as evolution, but may have implied it, inspiring early transmutationist thinkers. Among early works exploring the idea of a transmutation of species were Erasmus Darwin's (Charles Darwin's grandfather's) 1796 Zoönomia and Jean-Baptiste Lamarck's Philosophie Zoologique of 1809.[18] The idea was popularized in the Anglophone world by the speculative but widely read Vestiges of the Natural History of Creation, published anonymously by Robert Chambers in 1844.[47] With Darwin's theory, a general acceptance quickly appeared that a classification should reflect the Darwinian principle of common descent.[48] Tree of life representations became popular in scientific works, with known fossil groups incorporated. One of the first modern groups tied to fossil ancestors was birds.[49][better source needed] Using the then newly discovered fossils of Archaeopteryx and Hesperornis, Thomas Henry Huxley pronounced that they had evolved from dinosaurs, a group formally named by Richard Owen in 1842. [50][51] The resulting description, that of dinosaurs "giving rise to" or being "the ancestors of" birds, is the essential hallmark of evolutionary taxonomic thinking. As more and more fossil groups were found and recognized in the late 19th and early 20th centuries, palaeontologists worked to understand the history of animals through the ages by linking together known groups.[52] With the modern evolutionary synthesis of the early 1940s, an essentially modern understanding of the evolutionary taxonomic ranks, the two terms are largely interchangeable in modern use.[53] The cladistic method has emerged since the 1960s.[48] In 1958, Julian Huxley used the term clade.[18] Later, in 1960, Cain and Harrison introduced the term cladistic.[18] The salient feature is arranging taxa in a hierarchical evolutionary tree, with the desideratum that all named taxa are monophyletic.[48] A taxon is called monophyletic if it includes all the descendants of an ancestral form.[54][55] Groups that have descendant groups removed from the mare termed paraphyletic,[54] while groups are recognized and diagnosed on the basis of synapomorphies, shared derived character states.[56] Cladistic classifications are recognized and diagnosed on the basis of synapomorphies, shared derived character states.[56] Cladistic classifications are recognized and diagnosed on the basis of synapomorphies, shared derived character states.[56] Cladistic classifications are recognized and diagnosed on the basis of synapomorphies, shared derived character states.[56] Cladistic classifications are recognized and diagnosed on the basis of synapomorphies, shared derived character states.[56] Cladistic classifications are recognized and diagnosed on the basis of synapomorphies, shared derived character states.[56] Cladistic classifications are recognized and diagnosed on the basis of synapomorphies, shared derived character states.[56] Cladistic classifications are recognized and diagnosed on the basis of synapomorphies, shared derived character states.[56] Cladistic classifications are recognized and diagnosed on the basis of synapomorphies, shared derived character states.[56] Cladistic classifications are recognized and diagnosed on the basis of synapomorphies, shared derived character states.[56] Cladistic classifications are recognized and diagnosed on the basis of synapomorphies, shared derived character states.[56] Cladistic classifications are recognized and diagnosed on the basis of synapomorphies, shared derived character states.[56] Cladistic classifications are recognized and diagnosed on the basis of synapomorphies, shared derived character states.[56] Cladistic classifications are recognized and diagnosed on the basis of synapomorphies, shared derived character states.[56] Cladistic classifications are recognized and diagnosed on the basis of synapomorphies, shared derived character states.[56] Cladistic classifications are recognized and diagnosed on the basis of synapomorphies, shared derived c compatible with traditional Linnean taxonomy and the Codes of Zoological and Botanical nomenclature. [57] An alternative system of nomenclature or PhyloCode has been proposed, whose intent is to regulate the formal naming of clades. [58][59][unreliable source?] Linnaean ranks will be optional under the PhyloCode, which is intended to coexist with the current, rank-based codes.[59] It remains to be seen whether the systematic community will adopt the PhyloCode or reject it in favor of the current systems of nomenclature that have been employed (and modified as needed) for over 250 years. Kingdoms and domains The basic scheme of modern classification. Many other levels can be used; domain, the highest level within life, is both new and disputed. Main article: Kingdoms [60][unreliable source?] Linnaeus used this as the top rank, dividing the physical world into the vegetable, animal and mineral kingdoms. As advances in microscopy made classification of microorganisms possible, the number of kingdoms increased, five- and six-kingdom systems being the most common. Domains are a relatively new grouping. First proposed in 1977, Carl Woese's three-domain system was not generally accepted until later.[61] One main characteristic of the three-domain method is the separation of Archaea and Bacteria, previously grouped into the single kingdom Bacteria (a kingdom Archaea, but do not accept the domain method.[60] Thomas Cavalier-Smith, who published extensively on the classification of protists, recently[when?] proposed that the Neomura, the clade that groups together the Archaeo and Eucarya, would have evolved from Bacteria, more precisely from Actinomycetota. His 2004 classification treated the archaeobacteria as part of a subkingdom of the kingdom Bacteria, i.e., he rejected the three-domain system entirely.[63] Stefan Luketa in 2012 proposed a five "dominion" system, adding Prionobiota (acellular and without nucleic acid) and Virusobiota (acellular but with nucleic acid) to the traditional three domains.[64] Linnaeus1735[65] Haeckel1866[66] Chatton1925[67] Copeland1938[68] Whittaker1969[69] Woese et al.1990[70] Cavalier-Smith1998[63] Cavalier-Smi Eucarya Protozoa Protozoa Chromista Chromista Vegetabilia Plantae Plan replaced as new information becomes available; however, comprehensive, published treatments of most or all life are rarer; recent examples are that of Adl et al., 2012 and 2019,[72][73] which covers eukaryotes only with an emphasis on protists, and Ruggiero et al., 2015,[74] covering both eukaryotes and prokaryotes to the rank of Order, although both exclude fossil representatives.[74] A separate compilation (Ruggiero, 2014)[75] covers extant taxa to the rank of Family. Other, database-driven treatments include the Encyclopedia of Life, the Global Biodiversity Information Facility, the NCBI taxonomy database, the Interim Register of Marine and Nonmarine Genera, the Open Tree of Life, and the Catalogue of Life. The Paleobiology Database is a resource for fossils. Application Biological taxonomy is a sub-discipline of biology, and is generally practiced by biologists known as "taxonomy is a sub-discipline of biology, and is generally practiced by biologists known as "taxonomy is a sub-discipline of biology, and is generally practiced by biologists known as "taxonomy is a sub-discipline of biology, and is generally practiced by biologists known as "taxonomy is a sub-discipline of biology, and is generally practiced by biologists known as "taxonomy is a sub-discipline of biology, and is generally practiced by biologists known as "taxonomy is a sub-discipline of biology, and is generally practiced by biologists known as "taxonomy is a sub-discipline of biology, and is generally practiced by biologists known as "taxonomy is a sub-discipline of biology, and is generally practiced by biologists known as "taxonomy is a sub-discipline of biology, and is generally practiced by biologists known as "taxonomy is a sub-discipline of biology, and is generally practiced by biologists known as "taxonomy is a sub-discipline of biology, and is generally practiced by biologists known as "taxonomy is a sub-discipline of biology, and is generally practiced by biologists known as "taxonomy is a sub-discipline of biology, and is generally practiced by biologists known as "taxonomy is a sub-discipline of biology, and is generally practiced by biologists known as "taxonomy is a sub-discipline of biology, and is generally practiced by biologists known as "taxonomy as a sub-discipline of biology, and is generally practiced by biologists known as "taxonomy as a sub-discipline of biology, and is generally practiced by biologists known as "taxonomy as a sub-discipline of biology, and is generally practiced by biologists known as "taxonomy as a sub-discipline of biology, and is generally practiced by biologists known as "taxonomy as a sub-discipline of biology, and is generally practiced by biologists known as "taxonomy as a s the work conducted by taxonomists is essential for the study of biodiversity and the resulting field of conservation biology.[77][78] Classifying organisms Main article: Taxonomic rank Biological classification is a critical component of the taxon are hypothesized to be.
Biological classification uses taxonomic ranks, including among others (in order from most inclusive): Domain, Kingdom, Phylum, Class, Order, Family, Genus, Species, and Strain.[79][note 1] Taxonomic descriptions See also: Species, and Strain.[79][note 1] Taxonomi is encapsulated by its description or its diagnosis or by both combined. There are no set rules governing the definition of taxa, but the naming and publication of new taxa is governed by sets of rules.[8] In zoology, the nomenclature for the more commonly used ranks (superfamily to subspecies), is regulated by the International Code of Zoological Nomenclature (ICZN Code).[80] In the fields of phycology, mycology, and botany, the naming of taxa is governed by the International Code of Nomenclature for algae, fungi, and plants (ICN).[81] The initial description of a taxon involves five main requirements:[82] The taxon must be given a name based on the 26 letters of the Latin alphabet (a binomial for new species, or uninomial for other ranks). The name must be unique (i.e. not a homonym). The description must be based on at least one name-bearing type specimen. It should include statements about appropriate attributes either to describe (define) the taxon or to differentiate it from other taxa (the diagnosis, ICZN Code, Article attributes). 13.1.1, ICN, Article 38). Both codes deliberately separate defining the content of a taxon (its circumscription) from defining its name. These first four requirements must be published in a work that is obtainable in numerous identical copies, as a permanent scientific record. However, often much more information is included, like the geographic range of the taxon, ecological notes, chemistry, behavior, etc. How researchers arrive at their taxa varies: depending on the available data, and resources, methods vary from simple quantitative or qualitative comparisons of striking features, to elaborate computer analyses of large amounts of DNA sequence data.[83] Author citation Main articles: Author citation (botany) and Author citation (zoology) An "authority" may be placed after a scientific name.[84] The authority is the name of the scientific name.[84] For example, in 1758 Linnaeus gave the Asian elephant the scientific name elephas maximus, so the name is sometimes written as "Elephas maximus". Linnaeus, 1758".[85] The names of authors are frequently abbreviation L., for Linnaeus, is commonly used. In botany, there is, in fact, a regulated list of standard abbreviations (see list of botanists by author abbreviation).[86] The system for assigning authorities differs slightly between botany and zoology.[8] However, it is standard that if the genus of a species has been changed since the original description, the original authority's name is placed in parentheses.[87] Phenetics A comparison of phylogenetic and phenetic (character-based) concepts Main article: Phenetics, also known as taximetrics, or numerical taxonomy, organisms are classified based on overall similarity, regardless of their phylogeny or evolutionary relationships.[18] It results in a measure of hypergeometric "distance" between taxa. Phenetic methods do not distinguish shared derived ancestral (or plesiomorphic) traits from shared derived ancestral (or plesion and p (or apomorphic) traits.[88] However, certain phenetic methods, such as neighbor joining, have persisted, as rapid estimators of relationship when more advanced methods (such as neighbor joining, have persisted, as rapid estimators of relationship when more advanced methods.] catalogue classifications and their documentation.[90] While there is no commonly used database, there are comprehensive databases such as the Catalogue listed 1.64 million species for all kingdoms as of April 2016, claiming coverage of more than three quarters of the estimated species known to modern science.[92] See also Automated species identification Bacterial taxonomy Cluster analysis Consortium for the Barcode of Life Consortium of European Taxonomic Facilities Genetypes Glossary of scientific naming Identification (biology) Incertae sedis Open Tree of Life Parataxonomy Phenogram Set theory Taxonomy (general) Virus classification Notes ^ This ranking system, except for "Strain," can be remembered by the mnemonic "Do Kings Play Chess On Fine Glass Sets?" 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