TAXONOMIC CLASSIFICATION OF ANIMALS pdf

1: Animal Taxonomy | Garst Wildlife Photos | Libraries | Colorado State University

Animal Classification In order for us to understand how all living organisms are related, they are arranged into different www.enganchecubano.com more features that a group of animals share, the more specific the group is.

While biologists agree upon the classification system there are some exceptions; botanists may use the term Division instead of Phylum, and biologists often used more categories such as "subphylum" or "superclass" , there is often much discussion as to how organisms should be classified. Because biologists continue to learn more about the evolutionary history of life, the classification of organisms is being constantly argued and revised. To standardize our data collection, we will follow the five kingdom taxonomy scheme in our studies. We will focus our investigation on the animal kingdom. Below is a very abbreviated outline of the taxonomy of life, along with a general description of each taxon to help with some of your classification you will still need to do some library research on your own. Try to identify all of the animals you observe at your study site down to their order taxon. Despite the overall logic of the classification system, you will find that just about every taxon has "exceptions to the rule. K - Monera Greek - single, solitary: Simple cellular structure, no organelles prokaryotes vs. K - Protoctista Greek - very first to establish: The kingdom is defined by exclusion. Those organisms that are not plants, animals, or fungi. K - Fungi Latin, derived from Greek - sp h onges, sponges: Obtain food through absorption, excrete enzymes for digestion. K - Plantae Latin - plant: Multicellular organisms that are autotrophic make complex "food" molecules from basic constituents. K - Animalia Latin - breath, soul: Multicellular organisms that develop from the fertilization of an egg by a sperm. Heterotrophic obtain food by ingestion. There are approximately 32 Phyla in the animal kingdom. Only 12 are reported here. P - Porifera Latin - to bear pores: P - Cnidaria Greek - nettle: Also known as Coelenterates Greek - hollow intestine. Most are marine, some are freshwater.

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2: Animal Classification | Free Lesson Plans | Teachers

Taxonomy (from Ancient Greek ï„Î¬Î¾Î¹ï‚ (), meaning 'arrangement', and -Î½Î¿Î¼Î¯Î± (), meaning 'method') is the science of defining and naming groups of biological organisms on the basis of shared characteristics.

A flat paddle-shaped limb that many aquatic mammals have. Fluke Many whales and their relatives have a rubbery tail flipper which is known as a fluke. Foetus A developing animal that is nearing the time of birth. Food Chain An animal food chain is the sequence of who eats whom within an ecosystem in order for each animal to obtain nutrition. A food chain starts with the primary energy source, which is usually the sun and the food chain is then connected by a series of organisms that eat each other, in turn. The food chain starts with the sun and is then followed by the primary producers, then the primary consumer, then the secondary consumer, followed by the tertiary consumer and finishing with the quaternary consumer which is generally an animal that is eaten by nothing else and is therefore the end of the food chain. Food chains are never the same as each ecosystem contains different organisms within it. If one part of the food chain is missing then there will be high population levels in the links before the missing part of the food chain, as nothing is eating them, and there will also be lower population levels in the links after the missing part in the food chain, as those animals have nothing to eat. The food chain is then said to be out of balance, so it is crucial for food chains to remain unaltered in order for balance within the animal kingdom to remain. Primary Producer Primary producers are those organisms that require nothing but the natural resources of the Earth in order to thrive and survive. Primary producers tend to be plants that are photosynthetic and these plants use the energy provided by sunlight in order to make their own food using a process called photosynthesis. Other primary consumers include bacteria that make their own food using chemicals that are produced in natural vents in the ocean. Primary producers are also known as autotrophs and are vital to the survival of the animals that follow in the next stages of the food chain. Primary Consumer The primary consumers are the next stage in the food chain behind the sun and the primary producers. The primary consumers are the herbivorous animals of the world and consume the primary producers autotrophs in order to gain their nutrition. For example, an insect primary consumer will eat the seeds and sprouts that are provided by grass primary producer. Primary consumers are also known as heterotrophs. Secondary Consumer The secondary consumers link in with the food chain as they are the omnivorous animals that eat the primary consumers and the secondary consumers will occasionally eat the primary producers in order to supplement their diet. For example, a rat secondary consumer will eat an insect primary consumer that has gained its nutrition from eating the grass primary producer. Secondary consumers are also known as heterotrophs. Tertiary Consumer The secondary consumers are followed by the tertiary consumers, the tertiary consumers tend to be the smaller carnivores of the animal kingdom. The tertiary consumers only eat meat and therefore really on the consistency of the secondary consumer populations in order to continue to thrive as a species. For example, a snake tertiary consumer will eat a rat secondary consumer that has gained its nutrition from eating an insect primary consumer , and the insect has gained its nutrition from eating the grass primary producer. Tertiary consumers are also known as heterotrophs. Quaternary Consumer The final part to the food chain are the quaternary consumers, and these are the animals that tend to be large carnivores and dominant predators within their natural environment. Quaternary consumers generally have few, if any, natural predators at all and this tends to be where the food chain ends. For example, an eagle quaternary consumer will eat a snake tertiary consumer , that has eaten a rat secondary consumer , that has eaten an insect primary consumer , that has eaten the grass primary producer that has used the energy from the sun in order to make food.

TAXONOMIC CLASSIFICATION OF ANIMALS pdf

3: Classifying Animals - Mensa for Kids

ITIS Taxonomic Workbench Welcome to ITIS, the Integrated Taxonomic Information System! Here you will find authoritative taxonomic information on plants, animals, fungi, and microbes of North America and the world.

Genus Species Every animal on the planet, down to the most microscopic creature you can imagine, can be classified according to this system. You can remember the order the system comes in with one of the following phrases. The first letter of each word is the first letter of the level of classification. Pick the one you like the best and practice saying it five times. King penguins congregate on frozen ground sometimes. Keep ponds clean or frogs get sick. These levels start out broadly â€” that means the top levels have the most animals, and they get narrower and narrower as you go down. So, by the time you get to the species, there is only one animal in the group. You can imagine these levels as an upside-down triangle. Kingdom Generally, scientists agree there are six kingdoms. The animal kingdom called Kingdom Animalia is just one of those. Originally, Linnaeus only identified two kingdoms: Some scientists think that viruses should have their own kingdom, but currently they are not included under this system. Phylum Within the animal kingdom, the animals are divided into more than 30 phyla which is the plural of "phylum". Phylum Arthropoda contains insects, spiders and other animals with segmented bodies, like shrimp. Arthropods have their skeletons on the outside of their bodies think of the hard shell of a lobster and other characteristics in common. Class The third level of classification is class. For example, Phylum Chordata has classes in it like birds, mammals Mammalia and reptiles. Order The next level, or rank, is order. Orders are smaller groups within the different classes. Lepidoptera is the order of moths and butterflies. Carnivora is the order within Mammalia that has the most diversity in animal size. Family The fifth rank of classification is family. When you get to this rank, people sometimes disagree about which family an animal belongs to, so you may find that different sources tell you different things. This can even happen with orders. The family for dogs is Canidae. If animals are in the same genus, they are really closely related. In fact, you may not be able to tell them apart just by looking at them! When we write the name of the genus, we capitalize it and italicize it. For example, the genus of dogs and wolves, too! Species If animals can breed together successfully, they are a species. When an animal is called by its scientific name, then that means it is being identified by its genus and species. We use a lowercase letter and italics for the species. The scientific name of dogs is Canis familiaris; however, the scientific name of wolves is Canis lupus. Using that chart and the chart on the last page of this lesson, answer the following questions: Why do you think we left Kingdom off of the chart? What kingdom does each of these animals belong to? Look at the class of the Chilean flamingo. All birds belong to that class. Do you see why we call things to do with airplanes "aviation? If two animals are the same genus, then they must also be the same family, order, class, phylum and kingdom. Why did you make that choice? Why do you think that we had to be more specific about the animals in this chart? Why did we have to say "grizzly bear? Now think about the name of the whale suborder Odontoceti. Do you think these are whales with teeth or whales with baleen? The family that horses belong to, Perissodactyla, means "odd toed. Can you think of any other animals not on this chart that might belong to that family? Using the chart above, write the scientific names of the cow, the flamingo and the whale. Cow Chilean flamingo Blue whale Did you put the genus first with a capital letter? In the search box, put in your favorite animal. Now write out its classification:

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4: Taxonomy (biology) - Wikipedia

Classifying Animals The inventor of modern scientific classification was Carolus Linnaeus () a Swedish botanist who classified and described more than 4, species of animals and 7, species of plants.

Reptiles Classification of Animals To identify animals and learn more about them, it helps to become familiar with the way they are classified. Biologists arrange animals into groups on the basis of traits which they share with other animals and their genetic relationships with each other. This orderly way of classifying animals forms the basis of the field of study called taxonomy. Modern scientific taxonomy is based on physical characteristics such as teeth, skin, fur, feather, or scale patterns, size, or the structure of body parts and on genetic characteristics. Some key characteristics are basic to taxonomic descriptions. Others are not part of the basic description, but correspond to evolutionary relationships upon which taxonomic classifications are based. The field of study called systematics focuses specifically on the evolutionary relationships between living organisms. A Swedish scientist named Carolus Linnaeus laid the foundation of modern systematics with a work called Systema Naturae, which he published in Linnaeus wrote in Latin, the international language at the time, and Latin continues to be the basis of most scientific names. Sometimes the names of the various taxonomic categories are converted into forms that are more comfortable to everyday English; for example, instead of Mammalia we usually just say mammal. Linnaeus designed his system of classification so that each animal and plant that he described had one and only one correct name and this name would not be shared with any other organism. Then he presented a method for organizing all these named organisms into a series of nested groups, based on their similarities and differences. In essence, it became a type of filing system, with the top levels including many, many different kinds of organisms and the lowest levels containing but a single type of plant or animal. This hierarchical Linnaean system uses clearly defined shared characteristics to classify organisms into each group represented by these different levels. The most important categories in this hierarchical system, from higher and more inclusive to lower and more specific, are kingdom, phylum, class, order, family, genus, and species. A kingdom is one of the highest primary divisions into which all objects are placed. All animals are part of the Animal Kingdom. Each kingdom is divided into smaller units called phyla the plural form of phylum. For example, animals that have a nerve cord are classified as members of the Phylum Chordata. The chordates are further divided into classes such as Mammalia, Aves, Reptilia, and Amphibia. Members of each class have characteristics which they share with other members of their class, but which generally are not found in members of the other classes. Classes are divided into families. Families are subdivided into genera the plural form of genus ; and genera are subdivided into species. A family usually contains more than one genus, and each genus usually includes more than one species. Animals that share the same genus are very similar and probably evolved from a common ancestor. The species is the most fundamental unit and contains a single type of animal. For an example of how this works, consider the taxonomy of the domestic dog. As more is learned about a species, its classification may change. In order to manage changes in scientific names, there is an international committee which approves each proposed name change. They follow a set of rules outlined in the International Code of Zoological Nomenclature. No single classification is final, because additional studies may show new relationships among animals that were not clear using previous evidence. Scientific taxonomy is dynamic. Although some groups of animals are more subject to changes than others, new discoveries can lead to changes even among the best-known groups of animals. To learn more about the animals included here, you may wish to consult the listed references about an animal. Four general types of references are included: Higher taxonomies organize major taxonomic units in phylogenetic order, with the most primitive members of the group first and the most advanced last. Many such publications include a description of the distinguishing characteristics of the higher categories. Higher taxonomies provide guidance for arranging families and species in scientific publications and museum collections. Within each class, organisms are usually arranged in phylogenetic order. Classes are typically arranged either in ascending or descending hierarchical order; i. Regional checklists include species of a taxonomic group, such as a class or phylum, usually listed in phylogenetic order. Some of these are simply lists of scientific names with authors and dates and the major locations where the organisms occur, such as Atlantic Ocean, freshwater, or terrestrial. Others include a full taxonomic history and range for each species, but do not include common names or descriptions. Regional handbooks, biological surveys, and identification guides usually are arranged in taxonomic order and describe characteristics by which each species can be identified as well as biological characteristics, where and when the animal can be found, and other important information. As you make use of these references you will see that in many cases the names have changed. Scientific names represent biological relationships and are assigned to animals after careful study of each species. Many animals also have common names. Common names reveal what people think about animals and their ideas about how animals are related to each other. They also tell us about the importance of animals in our daily lives. Some common names match scientific taxonomy very closely. Other common names divide animals into more groups than scientists do, especially when the animal is very familiar to us or important in our lives. For example, there are many different names for breeds of household pets such as dogs, even though scientific taxonomy recognizes only one domestic dog species, Canis familiaris. Other animals are lumped together using similar common names in spite of very different biological histories. For example, many people use a single common name to refer to very different snakes and lizards because they do not know much about them. In Georgia, the name "gopher" refers to both a mammal and a turtle, even though it is clear that the Pocket Gopher is very different from the Gopher Tortoise. To make things even more complicated, the Pocket Gopher is sometimes called a "salamander," perhaps because of the sand mounds it creates. Thus, using only common names, the Pocket Gopher can be confused with a turtle as well as with the amphibians known as salamanders Order Caudata. Despite the possibility for confusion, common names are a widely recognized way of referring to animals. However, they lack the universal recognition needed for accurate identifications and scientific research.

5: Animal Classification - Reference - A-Z Animals

1. The scientific name for a horse is Equus caballus.A horse is a member of the genus _____.

Definition[edit] The exact definition of taxonomy varies from source to source, but the core of the discipline remains: Theory and practice of grouping individuals into species, arranging species into larger groups, and giving those groups names, thus producing a classification. There is some disagreement as to whether biological nomenclature is considered a part of taxonomy definitions 1 and 2 , or a part of systematics outside taxonomy. A whole set of terms including taxonomy, systematic biology , systematics, biosystematics , scientific classification, biological classification, and phylogenetics have at times had overlapping meanings â€” sometimes the same, sometimes slightly different, but always related and intersecting. This analysis may be executed on the basis of any combination of the various available kinds of characters, such as morphological, anatomical, palynological, biochemical and genetic. A monograph or complete revision is a revision that is comprehensive for a taxon for the information given at a particular time, and 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 within the taxon under study, which may result in a change in the classification of these subtaxa, the identification of new subtaxa, or the merger of previous subtaxa. The term "alpha taxonomy" is primarily used today to refer to the discipline of finding, describing, and naming taxa , particularly species. 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. He further excludes phylogenetic reconstruction from alpha taxonomy pp. 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 sophisticated computational or laboratory techniques. This activity is what the term classification denotes; it is also referred to as beta taxonomy. Microtaxonomy and macrotaxonomy[edit] 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. Earlier works were primarily descriptive and focused on plants that were useful in agriculture or medicine. There are a number of stages in this scientific thinking. Later came systems based on a more complete consideration of the characteristics of taxa, referred to as "natural systems", such as those of de Jussieu , de Candolle and Bentham and Hooker â€” These were pre- evolutionary in thinking. This was the concept of phyletic systems, from onwards. This approach was typified by those of Eichler and Engler â€" The advent of molecular genetics and statistical methodology allowed the creation of the modern era of "phylogenetic systems" based on cladistics , rather than morphology alone. It would always have been important to know the names of poisonous and edible plants and animals in order to communicate this information to other members of the family or group. Medicinal plant illustrations show up in Egyptian wall paintings from c. Again, several plant groups currently still recognized can be traced back to Theophrastus, such as Cornus , Crocus , and Narcissus. This included concepts such as the Great chain of being in the Western scholastic tradition, [26] again deriving ultimately from Aristotle. Aristotelian system did not classify plants or fungi, due to the lack of microscope at the time, [25] as his ideas were based on arranging the complete world in a single continuum, as per the scala naturae the Natural Ladder. Medieval thinkers used abstract philosophical and logical categorizations more suited to abstract philosophy than to pragmatic taxonomy. 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 â€" , who has been called "the first taxonomist". 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, â€" With his major works Systema Naturae 1st Edition in , [34] Species Plantarum in , [35] and Systema Naturae 10th Edition , [36] he revolutionized modern taxonomy. His works implemented a standardized binomial naming system for animal and plant species, [37] which proved to be an elegant solution to a chaotic and disorganized taxonomic literature. Even taxonomic names published by Linnaeus himself before these dates are considered pre-Linnaean. Spindle diagrams are typical for Evolutionary taxonomy The same relationship, expressed as a cladogram typical for cladistics Whereas Linnaeus aimed simply to create readily identifiable taxa, the idea of the Linnaean taxonomy as translating into a sort of dendrogram of the animal and plant kingdoms was formulated toward the end of the 18th century, well before On the Origin of Species was published. One of the first modern groups tied to fossil ancestors was birds. 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. As evolutionary taxonomy is based on Linnaean taxonomic ranks, the two terms are largely interchangeable in modern use. Many other levels can be used; domain, the highest level within life, is both new and disputed. Kingdom biology Well before Linnaeus, plants and animals were considered separate 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. His classification treated the archaeobacteria as part of a subkingdom of the kingdom Bacteria, i.

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6: What is the taxonomic classification of a horse? | Socratic

Classifying Animals. Download the PDF version of this lesson plan.. Introduction. This lesson explores the classification system used to identify animals. Most children are fascinated by animals and often have an animal that is a particular favorite, possibly even an animal the child has never seen before.

Popular fascination with the giant reptiles grew, reaching a peak inâ€¦ Historical background People who live close to nature usually have an excellent working knowledge of the elements of the local fauna and flora important to them and also often recognize many of the larger groups of living things e. Their knowledge, however, is according to need, and such people generalize only rarely. From the Greeks to the Renaissance The first great generalizer in classification was Aristotle , who virtually invented the science of logic, of which for 2, years classification was a part. Greeks had constant contact with the sea and marine life, and Aristotle seems to have studied it intensively during his stay on the island of Lesbos. In his writings, he described a large number of natural groups, and, although he ranked them from simple to complex, his order was not an evolutionary one. He was far ahead of his time, however, in separating invertebrate animals into different groups and was aware that whales, dolphins, and porpoises had mammalian characters and were not fish. Lacking the microscope, he could not, of course, deal with the minute forms of life. The Aristotelian method dominated classification until the 19th century. His scheme was, in effect, that the classification of a living thing by its natureâ€”i. These can then be used to develop a definition that states the essence of the living thingâ€”what makes it what it is and thus cannot be altered; the essence is, of course, immutable. The model for this procedure is to be seen in mathematics , especially geometry, which fascinated the Greeks. Mathematics seemed to them the type and exemplar of perfect knowledge, since its deductions from axioms were certain and its definitions perfect, irrespective of whether a perfect geometrical figure could ever be drawn. But the Aristotelian procedure applied to living things is not by deduction from stated and known axioms; rather, it is by induction from observed examples and thus does not lead to the immutable essence but to a lexical definition. Although it provided for centuries a procedure for attempting to define living things by careful analysis, it neglected the variation of living things. Aristotle and his pupil in botany, Theophrastus , had no notable successors for 1, years. In about the 12th century ce, botanical works necessary to medicine began to contain accurate illustrations of plants, and a few began to arrange similar plants together. Encyclopaedists also began to bring together classical wisdom and some contemporary observations. After this time, work in botany and zoology flourished. John Ray summarized in the late 17th century the available systematic knowledge, with useful classifications. He distinguished the monocotyledonous plants from the dicotyledonous ones in , recognized the true affinities of the whales, and gave a workable definition of the species concept, which had already become the basic unit of biological classification. He tempered the Aristotelian logic of classification with empirical observation. Page 1 of 9.

7: Glossary - Reference - A-Z Animals

Animal Taxonomy Hierarchy is a scientific procedure/ process used for the proper identification as well as for the classification of all animals on the earth.

Students will understand the following: Classification is the arrangement of objects, ideas, or information into groups, the members of which have one or more characteristics in common. Classification makes things easier to find, identify, and study. Scientific classification groups all plants and animals on the basis of certain characteristics they have in common. Scientific classification uses Latin and Greek words to give each animal and plant two names similar to a first and last name that identify the animal or plant. For this lesson, you will need: As an introduction to the activity, discuss classification in general. Ask students what we mean by classification and why we classify things. For example, why do we classify certain objects as tools, others as food, and so on? Establish that classificationâ€”the arrangement of objects, ideas, or information into groupsâ€”makes things easy to find, identify, talk about, and study. As background information, let students know that, beginning in ancient times, scientists tried to develop a system of classifying animals and plants. The system we use today was developed by the Swedish naturalist Carolus Linnaeus , who separated animals and plants according to certain physical similarities and gave identifying names to each species. On the chalkboard, reproduce the example below, which shows how a brown squirrel is classified: Kingdom Animalia, or "animal" Phylum Chordata, or "has a backbone" Class Mammalia, or "has a backbone and nurses its young" Order Rodentia, or "has a backbone, nurses its young, and has long, sharp front teeth Family Scuridae, or "has a backbone, nurses its young, has long, sharp front teeth, and has a bushy tail Genus Tamiasciurus , or "has a backbone, nurses its young, has long, sharp front teeth, has a bushy tail, and climbs trees Species hudsonicus , or "has a backbone, nurses its young, has long, sharp front teeth, has a bushy tail, and has brown fur on its back and white fur on its underparts 4. Discuss the example with the class, bringing out the idea that each subsequent level of classification eliminates animals that could be included in the previous level. To make this point, have students give examples of several mammals the class Mammalia and then tell which ones are eliminated by the description of rodents the order Rodentia ; have them name several rodents and then tell which rodents are eliminated by the description of the genus Tamiasciurus ; and so on. Tell students that it is not necessary to go through the entire seven-level classification system to identify a plant or animal. Just two namesâ€”the genus and species namesâ€”are sufficient. Thus, the scientific name for the brown squirrel is Tamiasciurus hudsonicus. Because two names are used, the system is known as the binomial two names system of nomenclature naming. Have students do some research in a biology book, encyclopedia, or online to find the genus and species names of some familiar plants and animals. Instruct each student to list on the chalkboard three or four scientific names he or she has found and the common names of the animals they identify. Divide your class into groups and have them devise their own system of classifying everyday objects around the room. Students should use at least four levels of classification, but they may use as many more levels as they find necessary. They should end up with a two-part name for each of several objects in the room. For example, the two "phyla" could be "natural" made of natural materials and "artificial" made of artificial materials ; or "useful" and "decorative. Students may use descriptive phrases rather than single words, and, of course, they should not be required to use Greek or Latin terms.

8: Life Science | Session 2

This orderly way of classifying animals forms the basis of the field of study called taxonomy. Modern scientific taxonomy is based on physical characteristics (such as teeth, skin, fur, feather, or scale patterns, size, or the structure of body parts) and on genetic characteristics.

Main ranks are in bold type; unnamed taxa are not counted. Prokaryota The higher classification of prokaryotes is still somewhat unsettled. Margulis and Schwartz [28] recognized the superkingdom Prokarya, containing one kingdom Bacteria that included a subkingdom Archaea; Cavalier-Smith also treated Archaebacteria and Eubacteria as prokaryote subkingdoms [19 , 29]. While these sources list the names of phyla in common use as a service to the user, they are not validly published under the ICNB. We have not placed phylum names in quotation marks as they have but we have so designated a few prokaryote names at lower ranks that are in common use but not or not yet valid. As no prokaryote names above the ranks of class are covered by ICNB rules, there is no official higher classification of prokaryotes [32] and any attempt at such is necessarily difficult. We have chosen to adopt the classification in current use by the Catalogue of Life. We treat them as de facto kingdoms until there is a better resolution of their status. Greater use of multigene trees rather than over reliance on rRNA gene trees alone may eventually allow further simplification by grouping them into fewer phyla, possibly only about half the present number [28]. Protozoa and Chromista Unicellular eukaryotes, usually called protists, comprise a polyphyletic group of eukaryotes that do not undergo tissue formation through the process of embryological layering. They include ancestrally unicellular eukaryotes directly descended from bacteria by the origin of the nucleus, endomembrane, cytoskeleton, and mitochondria. Assigning them to separate kingdoms was historically difficult when only light microscopy was available but is now considerably facilitated because of advances in electron microscopy and gene sequencing. Formerly, the unicellular amoeboid group Myxozoa with multicellular spores was included in Protozoa but these protists are now firmly within the animal kingdom, having been proven to be greatly simplified parasitic animals. Yeasts are unicellular fungi that evolved polyphyletically from multicellular filamentous ancestors and are assigned to one of three higher fungal phyla. Microsporidia are highly reduced intracellular parasites traditionally considered to be Protozoa, but they have been known for two decades to be related to Fungi. At one time it was thought microsporidia had evolved from Fungi and therefore were placed in that kingdom [19 , 33]. For several years multigene trees were contradictory about whether microsporidia branched within or diverged from Fungi. The latest evidence is that they are most closely related to rozellids [34], which also have been treated either as Fungi or Protozoa. If this recent phylogeny [34] is correct, both should be in the same kingdom. Here we take the view that the best demarcation between Protozoa and Fungi lies immediately before the origin of the chitinous wall around vegetative fungal cells and associated loss of phagotrophy [33]. We therefore include microsporidia and rozellids in Protozoa vegetatively wall-less, typically phagotrophs not Fungi vegetatively walled osmotrophs. For decades, taxonomists have debated the boundary between Protozoa and Plantae. We accept the view that it should be placed just prior to the evolutionary origin of chloroplasts and that Plantae should comprise all eukaryotes with plastids directly descending from the initially enslaved cyanobacterium, i. Therefore, all green algae are included in Viridiplantae and Plantae and are excluded from Protozoa. The only photosynthetic Protozoa are Euglenophyceae, which obtained their chloroplasts subsequently from an enslaved green alga [21]. The boundary between Protozoa and Chromista has been more controversial. Chromista was established to include all chromophyte algae those with chlorophyll c, not b considered to have evolved by symbiogenetic enslavement of another eukaryote a red alga as well as all heterotrophic protists descended from them by loss of photosynthesis or entire plastids [35]. With phylogenetic advances it has become clearer that alveolates once considered Protozoa are related to chromistan heterokont algae and related heterotrophic heterokonts and more distantly to Rhizaria, the three together forming the major group Harosa equivalent to SAR. Consequently, Chromista has been greatly expanded to include all Harosa as well as other former protozoa that turned out to be related to haptophytes or cryptophytes. Chromista now includes many groups once treated as Protozoa [19], an expansion followed here. In multigene trees, this expansion is the most difficult part of the entire eukaryote tree to resolve. They sometimes show one or both of Plantae and Chromista as a clade but often their major subgroups are intermingled in contradictory ways [36 , 37]. This may be a consequence of the eukaryote-eukaryote chimaeric history of chromists that acquired some genes from red algae or of the very rapid basal radiation of the robust corticate clade i. Because of this, some question whether Chromista represents a clade, yet trees are still too poorly resolved to eliminate the likelihood from cell evolutionary considerations that Chromista and Plantae are genuinely distinct sister clades. Evidence that Harosa is a clade is very strong. Evidence that Haptista plus Cryptista are a clade Hacrobia is strong on some trees but questioned by others [37]. Protozoa, like Prokaryota, is certainly a paraphyletic taxon [38]; Animalia, Fungi, Plantae, and Chromista all evolved from it. In our hierarchy Protozoa comprises seven phyla, of which four are probably clades and three paraphyletic. We do not consider it useful in a general classification to subdivide the paraphyletic phyla into numerous smaller ones, often with only a handful of species that most have never heard of, even though a few specialists might favor that despite their constituent subgroups not differing radically in cell structure. For both Protozoa and Chromista we have favored large groups with shared body plans, analogous to extremely diverse animal phyla like Chordata and Arthropoda. The higher proportion of ancestral paraphyletic phyla in Protozoa compared with terminal groups like animals and plants is unsurprising because they were the first eukaryotes and they diverged early on but with many fewer associated major changes in body plan than occurred during the much later radiation of bilateral animals. Distinct early diverging protozoan clades can be remarkably similar morphologically and biologically [39]. Fungi As stated earlier, we take the view that the best demarcation between Protozoa and Fungi lies immediately before the origin of the chitinous wall around vegetative fungal cells and associated loss of phagotrophy. We use an updated version of the higher classification presented in the 10th Edition of the Dictionary of Fungi [40]. The evolutionarily convergent Oomycetes such as the serious pest Phytophthora, formerly treated as Fungi, belong instead in phylum Pseudofungi of the heterokont Chromista. Plantae As with the other kingdoms, Plantae is classified in a variety of ways. Margulis and Schwartz [28] restricted Plantae to land plants embryophytes or higher plants and popularized the use of kingdom Protoctista to include lower plants green, red, and glaucophyte algae and lower Fungi as well as chromists with classical protozoa. Many now consider such a kingdom too broad and heterogeneous and the associated separation of lower and higher plants in different kingdoms to be undesirable. Now taxonomists almost universally classify lower and higher plants together in the single kingdom Plantae and lower and higher fungi within the single kingdom Fungi. We have adopted this delimitation of Plantae here [19 , 35] for which Archaeplastida [12 , 18] is a less familiar recent synonym. The structure of plastid genomes and the derived chloroplast protein-import machinery support a single origin of glaucophytes, red algae, green algae, and embryophytes land plants. The ancestral embryophyte is thought to have originated from relatives of the Charales stoneworts or Coleochaetales Charophyta. Jeffrey [41] first grouped charophytes and embryophytes as a clade Streptophyta, which was later validated as a superphylum [42] and reduced to phylum by Bremer [43]. Here we recognize four embryophyte phylaâ€”three of bryophytes liverworts, hornworts, and mosses and a single phylum Tracheophyta for vascular plantsâ€—with all species characterized by a diploid phase having xylem and phloem. Bryophyte specialists tend to treat each of the three major bryophyte groups as phylaâ€—Marchantiophyta, Anthocerotophyta, Bryophyta [45 , 46]. We have chosen a conservative approach to the higher classification of plants, largely consistent with Mabberley [47] for the embryophyte ranks above class, while using Chase and Reveal [44] and Stevens [48] for the lower ranks. Based on the contributions of taxonomic experts to an outline of higher level classification and survey of taxonomic richness [60 , 61], as many as 39 animal phyla might be recognized more, if Porifera were abandoned as a phylum and constituent major clades given higher rank [62]. Below we discuss some issues encountered in arriving at decisions for our proposed classification, which accepts 34 animal phyla. Until the issue is resolved, we will follow the Porifera community [65 â€” 67] in retaining one phylum Porifera with four classes. We classify Myxozoa as a subphylum of Phylum Cnidaria. Whereas the stem-cell system and the mode of replacing epidermal cells unite both Acoela and Rhabditophora and are not found in any other bilaterian lineage, phylogenomic data support a separation of these two groups, a conclusion reached by Philippe et al. We follow Philippe et al. The remaining internal classification of Platyhelminthes is also somewhat problematic. We propose a classification that is based in part on Riutort et al. Until recently, all four of these groups were commonly treated as separate phyla [28 , 61 , 76 â€” 80]. However, numerous recent molecular and morphological analyses nest Acanthocephala within Rotifera [81 â€" 86]. A syncytial epidermis links rotifers, Seison and Acanthocephala; Ahlrichs [87 , 88] proposed Syndermata for this clade. As revealed by transmission electron microscopy [89] and scanning electron microscopy [90], the jaw apparatus of gnathostomulids and rotifers is remarkably similar. That of Seison is less obviously homologous [91] and the Seisonidea may have diverged from rotifers at an early stage of their evolution. On the other hand, Seison has similar sperm to acanthocephalans and the epidermis of both groups contains bundles of filaments. Limnognathia maerski, representing a new category of organism Micrognathozoa from cold fresh waters in Greenland and the Crozet Islands [92 , 93], has a remarkable jaw apparatus the most complicated known among invertebrates with clear homologies, in both the jaw elements and musculature, with the trophi in Rotifera and the jaws in Gnathostomulida. The jaw apparatus and musculature, as well as molecular analyses, unite these taxa as a clade known as Gnathifera see [86 , 92]. In the analysis by Giribet et al. We treat each of the major gnathiferan groups as a phylum, including Acanthocephala, following Monks and Richardson [79], though some of us think that the number of gnathiferan phyla ought to be substantially reduced when their phylogeny, including ingroup relationships of Rotifera sensu lato, is more firmly established. The first three of these phyla have in common an eversible snout introvert with scalid spines and inner and outer retractor muscles, a similar excretory filter protonephridium , and similar sense organs, providing strong justification for uniting them in a single clade, the Scalidophora [97]. There is also molecular support, though not unanimity, for a clade of Kinorhyncha, Loricifera, and Priapula, known as Scalidophora. On the other hand, Kinorhyncha has internal and external body segmentation lacking in the other groups. Neuhaus and Higgins [98] noted that conflicting evidence exists for every one of the possible sister-group relationships among these phyla and prefer to keep them separate in a superphylum Scalidophora which is preferred over Cephalorhyncha, the latter name originally including the Nematomorpha. We recommend separate scalidophoran phyla, though the number might be greatly reduced when the phylogeny becomes clearer. Nielsen [95] maintains Urochordata or Tunicata and Cephalochordata as separate phyla, whereas the group Urochordata is closer to Vertebrata craniates , in a clade Olfactores, than Cephalochordata. We retain all three groups as traditional chordate subphyla. Many users of classifications would prefer a stable, unchanging system. Yet classifications are syntheses of biological knowledge, particularly contemporary phylogenetic understanding of taxa, that must be regularly updated in accord with new scientific discoveries. Taxonomy must therefore navigate between the dual perils of ignoring important advances and making premature or unnecessary changes. We seek stability in nomenclature at the species level but at higher levels the concepts and compositions of major taxa, and therefore the scope of well-known names, must inevitably shift as new organisms are discovered and evolutionary affinities are better understood. The fact that we have been able to agree on a practical unified classification shows that taxonomists can broadly agree, despite the diverse experiences, viewpoints, and to some extent, differing philosophies of classification represented on our panel. The present classification as, indeed, all classifications should be regarded as interim, and it will inevitably change in certain respects, some hinted at above. However, we suspect that the recent torrent of radical re-evaluations resulting especially from the application of DNA sequencing and other new techniques may lessen as time passes. We hope that this unusually comprehensive classification will be widely useful and provide a sound basis for further improvement. Below the rank of infrakingdom, we have followed the convention used in the Catalogue of Life and listed taxon names alphabetically. This allows easier searching by those not familiar with the phylogenies of the many taxa therein and provides for easier import and manipulation of data by information systems. Table 2 Proposed hierarchical classification from superkingdom to order.

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Taxonomy is the grouping or categorizing of things into an outline or tree structure. In the scientific classification system, biologists group and categorize every organism, living or extinct, into kingdom, phylum, class, order, family, genus, species.

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