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Peter Littlewood writes...

When I'm out in the field with a group of young people, nothing captures the imagination like a sighting of an animal species.

It could be something as commonplace as a rabbit nibbling some grass, or as dramatic as a peregrine falcon on the lookout for prey or perhaps a group of roe deer crossing the path ahead of us. Perhaps it could even be a dragonfly that has caught a bee on the wing, and is now sitting contentedly (and audibly) munching its way through the bee's exoskeleton.

Plants are fascinating too. What about the sundew, which lures unsuspecting flies to a sticky end in its clutches? Or the wild arum, the berry-like fruit of which can be fatal when eaten, even in small doses? Or perhaps an ash tree, with its flexible wood that was so valuable in the construction of longbows? Curiosity grows. There is an enormous diversity of animal and plant species in the British countryside, if you take time to look.

Once eyes have been opened, "What's that?" is a question that will inevitably be asked, and frequently. Often the answer is quite straightforward, but sometimes, in the case perhaps of a small beetle, or perhaps a kind of spider, there is no common name for them, probably because they're not that common! In that case, we have to resort to an often strange sounding pair of Latin words, which together identify the species, and it may well be that we find them by looking them up in a field guide. We can't know everything – there's just too much to see!

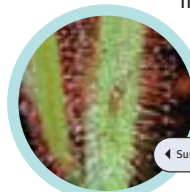
It was the Swedish scientist, Carolus Linnaeus, who first came up with the idea of classifying animal and plant species in different

families, and it was he also who came up with the binomial nomenclature (double-barrelled naming format) that we have used ever since to give names to species. In 1753 he published his comprehensive guide to the

7,700 plant species that had been discovered at that time, and in 1758, he published his comprehensive guide to all 4,400 known animal species.

We have since discovered countless thousands of new animal and plant species, all of which have been given names using Linnaeus' system of classification. We are still discovering new species.

There is so much still to find and learn more about. Why not encourage your class to take a look around the school playground (when the weather gets warmer again) and see how many 'new' species they can discover and identify?!



◀ Sundew



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Looking at Living Things

What exactly is an animal? Well, it's a *living organism*. Anything that is alive is a *living organism*. How do we know if something is alive?

You can tell if an animal is alive by giving it a prod – if it moves away, then it's alive! But not all living organisms move. You can prod a tree as hard as you like and it won't move away! But trees are living things.

What then is a living organism? It is something which can grow, respire (take in oxygen), excrete (get rid of waste), reproduce and is sensitive to changes in its surroundings. Some living organisms can move.

If you look around you, you can see many different organisms – people,

flowers, trees, dogs, birds, insects and many more. Some organisms look very much alike but some are very different.

Biologists (people who study the science of life) have estimated that there are at least 35 million species (particular kinds of living organisms) on Earth. So far only 5 million of them have been discovered and classified. Most of the “unknown” millions awaiting discovery live in tropical rainforests. This enormous variety of life on Earth is sometimes known as “**biological diversity**” or “**biodiversity**”.



Naming Living Organisms - Classification



Many living things have an everyday name. Some of them even have several different everyday names. For example, the wild plant usually called Lords and Ladies is also known as ‘cuckoo pint’, ‘jack in the pulpit’, ‘Adam and Eve’ and ‘sweethearts’ in different parts of Britain.

Sometimes different living things are given the same everyday name. For example, the bird known as a robin in Britain is different from the bird known as a robin in the USA.

Everyday names can therefore cause a lot of confusion! This is why every one of the 5 million living organisms known to Science has been given a special biological name. This means that people are able to describe a particular living thing to one another and be certain that they are talking about the same organism.

It helps us to decide which organism is which if we can put them into groups that have things in common. This ‘grouping’ is known as **classification** and it makes things easier to identify and study. Classification helps to make sense of biodiversity.

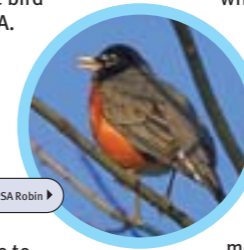
In 1735, the Swedish naturalist Carolus Linnaeus worked out the classification system that we use today. He separated living things into groups and gave identifying names to each particular type of organism.

Linnaeus thought that as many characteristics (distinctive features) as possible should be used to describe species. Some species share characteristics with other species and some characteristics are unique to the species. This means that species with the same characteristics can be put into groups. There are groups within groups. For example, there are several species of squirrel but they all share a number of characteristics, such as bushy tails and long, sharp front teeth. This means that they can be put into the same groups. However, each species of squirrel has its own distinctive features, which means it has to be given its own particular name. A species is a single organism, not a group.

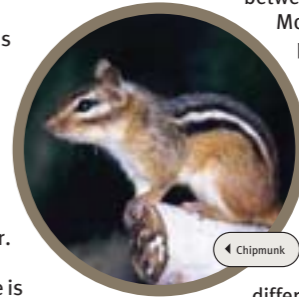
Linnaeus’ system gives each living thing two parts to its name. The first part of its name is the name of the **GENUS** group to which it belongs. The second part of the name is the organism’s **SPECIES** name (there may be several species within a genus). This classification method is called the **binomial system** (this comes from Latin words meaning ‘two names’). The genus name should always begin with a capital letter; the species name begins with a small letter. For example, the red squirrel’s binomial name is *Sciurus vulgaris*; the grey squirrel’s is *Sciurus carolinensis*. Note that they both belong to the same genus, *Sciurus*. This is because they are tree-climbing squirrels. Squirrels that live mainly on the ground, such as chipmunks, belong to a different genus.

The binomial system prevents any confusion over everyday names. For example, each of the robins mentioned earlier has a binomial name, so that ornithologists (people who study birds) can distinguish between them. The North American robin’s name is *Turdus migratorius* and the British robin’s name is *Erithacus rubecula*.

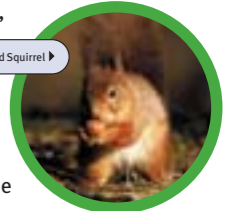
Linnaeus’ system classifies plants and animals on several levels, using Latin and Greek words. The **squirrels** are members of a particular **FAMILY** of animals that belong to the **ORDER** called **rodents** (which includes other animals with long, sharp, gnawing front teeth, like mice and rats). The rodents belong to the **CLASS** called **mammals** (animals whose young are fed on their mother’s milk and usually have fur). Mammals belong to an even bigger group called a **PHYLUM**.



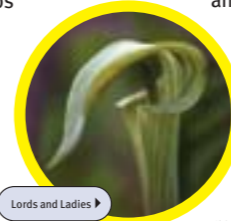
USA Robin ▶



◀ Chipmunk



▶ Red Squirrel



Lords and Ladies ▶

Their phylum is called **vertebrates** because they have a backbone.

The **phyla** (plural of phylum) come together in the largest group of all, known as a **KINGDOM**. The two most well known kingdoms are the **animal kingdom** and the **plant kingdom**. It is usually very easy to tell the difference between a plant and an animal.

Most animals move from place to place, whereas plants do not. Most plants have green leaves and use them to capture the Sun’s energy. Using this energy, the plants make their own food (a process known as **photosynthesis**). This is the most important difference between them.

Animals cannot use the Sun’s energy directly, so they have to eat other plants or animals to get energy. With these differences in mind, it is obvious that squirrels belong to the animal kingdom.

To summarise, here are the main groups used in classifying the British **red squirrel**, *Sciurus vulgaris*.

Kingdom	Animalia, or animal
Phylum	Chordata, or vertebrate
Class	Mammalia, or mammal
Order	Rodentia, or rodent
Family	Sciuridae – the squirrel family (rodents with a bushy tail)
Genus	Sciurus – the squirrels that climb trees
Species	<i>Sciurus vulgaris</i> – the squirrel with bright, chestnut fur and ear tufts



A Quick Look at the Animal Kingdom

Animals have been on this planet for over a billion years and the variety of animal life is enormous – from the gigantic whales that swim in the oceans to the tiniest of “bugs” that live buried in the soil.

Scientists have named almost two million species of animal and more are discovered every year! Classifying them has become very complicated! There are over thirty phyla of animals and they are further split into several classes, orders and families. Some families contain thousands of species.

Here is a list of just a few of the most well known phyla of animals:

Chordate Phylum: the vertebrates, which are all the animals with a backbone. There are five classes of vertebrates – mammals, birds, reptiles, amphibians and fish.

Vertebrate animals make up less than 3 per cent of all the world’s animals. All the rest are collectively known as **invertebrates** – animals without a backbone.

Arthropod Phylum: the largest phylum in the animal kingdom, made up of millions of species with “jointed legs” –



includes the classes of insects, arachnids (spiders & relatives) and crustaceans (crabs and relatives).

Mollusc Phylum: animals with a soft body that sometimes have a hard shell. About 100,000 species. Examples are snails, slugs, octopuses, squid, oysters and clams.



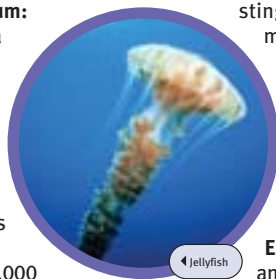
Annelid Phylum: worms with a segmented body. About 12,000 species. Examples are earthworms and leeches.

Nematode Phylum: the nematodes, also called roundworms, are very common, small worms with no segments. About 20,000 species. Some are parasites, living inside other animals and plants.

Porifera Phylum: the simplest of all animals belong to this phylum – the

sponges. About 10,000 species. Most live in the sea, attached to rocks etc.

Cnidarian Phylum: Soft, jelly-like animals with tentacles and stinging cells around their mouths. About 8,000 – 9,000 species. Most live in the sea. Examples are jellyfish, corals, sea anemones and hydra (tiny cnidarians that live in freshwater habitats like ponds).



Echinoderm Phylum: animals usually with spiny bodies, divided into five equal parts or “arms”. About 6,000 species, living either on the seashore or seabed. Examples are starfish and sea urchins.

Platyhelminthes Phylum: also called flatworms, they are worms with soft, flat bodies. About 17,500 species. Most are parasites, living inside other animals, but some live in the sea or freshwater habitats. Examples are tapeworms and liver flukes.



A Detailed Look at the Vertebrates

As we have seen, vertebrates are the animals with a backbone. They are probably the most well known of all animals and include the world’s largest, the fastest, and the most intelligent species on Earth.

This does not mean that they are more important than the invertebrates, but because they are larger we notice them more. Many of them are also very useful to us, providing food and clothing.

We will now look more closely at the characteristics of the five classes of vertebrates.

Mammals

These animals all feed their young on milk produced by the mother’s mammary glands (after which the class is named). Most mammals give birth to live young and almost all mammals have fur or hair covering their bodies.

Biologists have divided the mammals into several different groups. To date there are about 21 orders, 140 families and 4,475 species. Here are a few of the orders:

Carnivora Order: called carnivores. These are predators (hunting animals) that eat other animals. Examples are dogs, cats, bears, weasels, otters, skunks and the meerkat.

Insectivora Order: called insectivores. Small mammals that eat insects and other invertebrates. Examples are shrews, moles and hedgehogs.

Chiroptera Order: this is the order for the bats – the only mammals that can truly fly. Bats make up almost a quarter of all mammal species.

Rodentia Order: called rodents. This is the largest order of mammals – over 40% of mammals are rodents. They all have long front teeth (incisors) adapted for gnawing. Most rodents are herbivores (eat plant food). Examples are mice, rats, voles, squirrels, guinea pigs, hamsters and beavers.

Lagomorpha Order: these ‘rabbit like’ mammals have long incisors like the rodents but they have two sets instead of just one and their skulls have a different structure. They are all herbivores. Lagomorphs include rabbits, hares and pikas.

Cetacea Order: the largest animals in the world are cetaceans – the whales. Their cousins, the dolphins and porpoises belong to this order too. Well adapted for life in water, with a fish-like, hairless body, but like all mammals

they breathe air with lungs and feed their young with milk.

Primates Order: there are about 356 species of primate, ranging from tiny lemurs to the huge gorillas. This is the order to which we humans belong and our closest relatives are the great apes – gorillas, chimpanzees and orang-utans. All

primates have a large, domed braincase and forward-facing eye sockets. Monkeys and gibbons are also members of the primate order.

All the above orders include the **mammals** that are known as **placentals**. This means that their babies complete their development inside the mother attached to her by a placenta. Through this placenta the baby receives food and oxygen and wastes pass from the baby to the mother across the placenta.

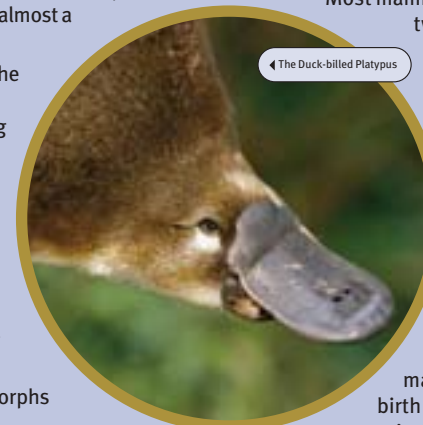
Most mammals are placentals, but there are two orders of mammals whose members do not have placentas. However, they do feed their young with milk. The two orders are:

Monotremata Order: the monotremes are egg-laying mammals. There are five species – the duck-billed platypus from Australia, and four species of spiny anteaters (echidnas) from Australia and New Guinea.

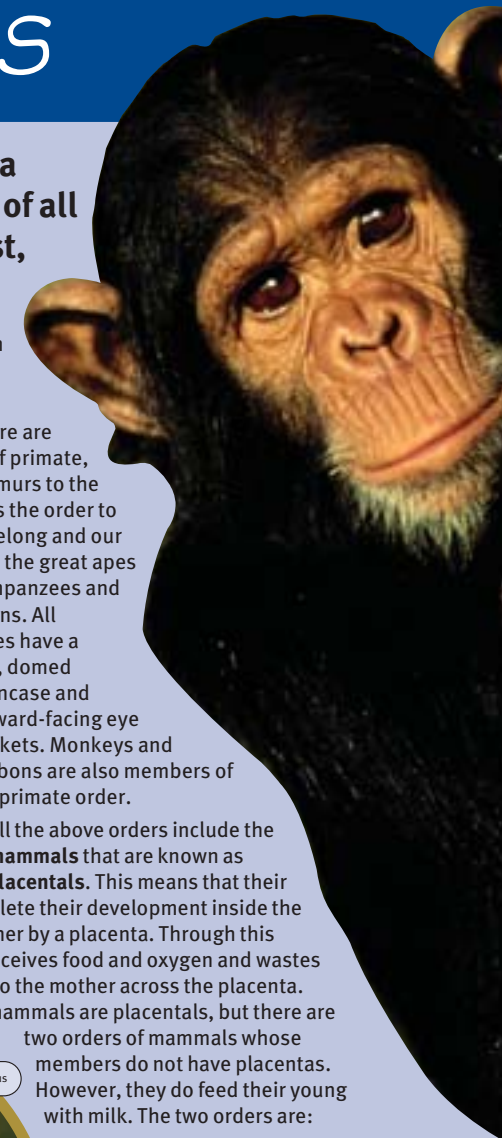
Marsupialia Order: the marsupials are mammals that give birth at a very early stage of the young’s development and they develop in the mother’s pouch (a marsupium) attached to a milk nipple. There are 292 species of marsupial, belonging to 22 families. Examples are kangaroos, wallabies, opossums, wombats and the koala.



◀ Ring-tailed Lemur

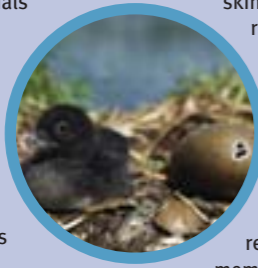


◀ The Duck-billed Platypus



Birds

Birds are easy to recognise, as they are the only animals with feathers. They have hollow bones and the feathers allow many bird species to fly. Birds reproduce by laying hard-shelled eggs. There are many different types of birds and they are usually grouped into 29 orders. Here are a few of those orders:



Passeriformes Order: the passerines are known as perching birds and they make up the largest order in the bird world. There are about 80 families and about 5,500 species. The familiar songbirds of the garden are passerines. Examples are robins, thrushes, swallows, cuckoos, sparrows and finches.

Sphenisciformes Order: this is the order for the penguins, of which there is just one family with 17 species. Penguins cannot fly. They are excellent swimmers, 'flying' through the water using their flipper-like wings.



Falconiformes Order: sometimes called raptors, the birds of prey are the top predators of the bird world. There are 5 families and 307 species. They are highly skilled hunters with their superb eyesight, strong legs and sharp beak and talons. Examples are falcons, hawks, eagles and vultures.

Piciformes Order: woodpeckers and toucans belong to this order. There are 6 families and 380 species. They all have the same foot design, with two toes pointing forwards and two pointing backwards. This helps them to climb trees easily. They all nest in holes, the woodpeckers having a strong, chisel-like beak to make their own nest holes in tree trunks.

Reptiles

Reptiles are vertebrates with dry, thick skin covered with hard scales. Most reptiles lay soft, leathery-shelled eggs on the land, but some give birth to live young. There are 4 orders – here are the most well known ones:

Chelonia Order: zoologists usually refer to all the members of this order (there are 11 families and 294 species) as turtles. Normally we know the ones that live in the sea as turtles, the land-living ones as tortoises and we call the turtles in fresh water terrapins. They all have a hard shell that helps to protect them from predators.

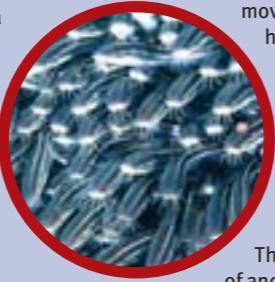
Squamata Order: the snakes and lizards belong to this order. The snakes are put into a group of their own (a suborder) called **Serpentes** of which there are about 18 families (biologists are not yet certain exactly how snake families should be classified) and 2,900 species. Snakes have no legs and no eyelids and they are all carnivores, eating a variety of animal life.

There is also disagreement amongst biologists as to how lizards should be classified! However, they belong to a suborder called **Lacertilia** of which there are about 19 families and about 4,500 species.

Crocodylia Order: the crocodiles, alligators and caimans were on this planet at the same time as the dinosaurs and have changed little over the last 65 million years. There are 3 families and 23 species of crocodylians and they are all fearsome predators that spend a lot of their time in water.

Amphibians

These are vertebrates with soft, thin, damp skin that quickly dries out in dry air. They live at least part of their life in water, but they can live and breathe on the land too. There are 3 orders of amphibians but the frogs and toads make up by far the biggest and best-known one,



called the **Anura Order**. There are 29 families of frogs and toads and 4,380 species.

Amphibians reproduce by laying eggs in water and the young (tadpoles) have to live and develop in a watery habitat such as a pond. The tails of frog and toad tadpoles shrink during their development, unlike newt and salamander amphibians that keep their tails throughout their lives.

FISH: fish were the first vertebrates to appear on Earth and they form the biggest group of vertebrates. There are about 24,500 species and because some fish are different in many ways to others, biologists divide them into 4 separate classes and 62 orders.

The largest class of fish, called **Osteichthyes**, includes nearly all the fish in the world, about 23,500 species. These fish are often called 'bony fish', and their bodies are covered in thin, wet, smooth scales. They breathe in oxygen from the water using gills that are covered by a single flap. Fins and a streamlined body help them to move around their watery habitat with ease. Bony fish have a swim bladder, a sac filled with gas that helps the fish to control its depth in the water. Examples of bony fish are catfish, eels, cod, herrings and salmon.

There are about 810 species of another type of fish commonly called 'cartilaginous fish'. They belong to a class called **Chondrichthyes**. Their skeleton is not made of bone, but of cartilage (the firm, white, smooth elastic material that covers the end of our bones where they meet other bones).

Cartilaginous fish do not have a flap covering their gills and they have no swim bladder. A cartilaginous fish has special teeth that fall out and are replaced as the fish grows. The scales are tiny, sharp and tooth-like, giving the skin a texture like sandpaper. Some of the largest and most ferocious predators of the sea belong to this group. Members are sharks, skates and rays.

Warm or Cold – Controlling the Temperature

The mammals and birds are the most widespread vertebrates, living in every major habitat in the world, even surviving the freezing temperatures of the polar seas.

This is because they are **warm-blooded**, which means that the temperature of the inside of their body remains the same all the time. This allows them to keep active whatever the temperature of their surroundings.

Fish, amphibians, reptiles and all invertebrates cannot maintain a steady body temperature and they are known as **cold-blooded**. This does not mean that their blood is cold all the time but that their body temperature changes along with that of their surroundings. As the outside temperature rises, the body temperature of a cold-blooded animal rises and it becomes more active. As the outside temperature drops, the animal slows down. Some of these creatures manage to live in temperate climates (those, like in Britain, where there is a wide change of temperature throughout the year) by hibernating in the winter.

Some reptiles can control their body temperature to a certain degree by sunbathing. After spending a cold night somewhere, perhaps underground, lizards often bask in the early morning sun so that their bodies soak up the sun's heat energy and their body temperature is raised, allowing them to become active as quickly as possible.



Chameleon ▶



Dormouse hibernating ▶





Did you know?

The blue whale (*Balaenoptera musculus*) is the biggest animal on our planet. It can grow to over 30 metres in length and weigh 200 tonnes – as much as 60 elephants!

The Goliath bird-eating spider (*Theraphosa leblondi*) is the world's biggest spider and lives in the rainforests of Surinam, Guyana and French Guiana. Specimens with a leg-span of over 27cm have been found!

The biggest crustacean is the giant spider crab (*Macrocheira kaempferi*) of Japan. An average rowing boat would easily fit between its outstretched claws, which grow up to 3.5m across!

The smallest mammal on Earth is the bumblebee or Kitti's hog-nosed bat (*Craseonycteris thonglongyai*), from Thailand. Its body is no bigger than a large bumblebee!

The peregrine falcon (*Falco peregrinus*) is the fastest animal in the world, reaching speeds of at least 124mph when stooping from great heights.

The world's biggest bird is the North African ostrich (*Struthio camelus camelus*). This flightless bird can reach 3m in height and weigh 156kg!

The largest reptile in the world is the estuarine or saltwater crocodile (*Crocodylus porosus*), which lives in the tropical areas of Asia and the Pacific. The largest one ever recorded was over 7 metres (29 feet)!

The Chinese giant salamander (*Andrias davidianus*) is the biggest amphibian on Earth. It lives in mountain streams in a few areas of China and the largest specimen ever found measured almost 3 metres in length and weighed 65 kg!

The dwarf pygmy goby (*Pandaka pygmaea*) is the world's smallest freshwater fish, which lives in the lakes and streams of Luzon in the Philippines. Its marine cousin, the dwarf goby (*Trimmaton nanus*), is found in the Indo-Pacific region. These tiny fish are the shortest known vertebrates and they measure only 1cm!

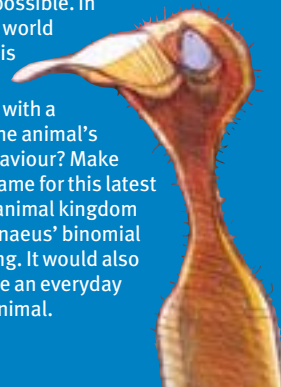
The largest fish in the world is the whale shark (*Rhincodon typus*), which grows up to 15m and weighs 20 tonnes!



Classification Challenge!

Imagine that you are a professional biologist who has just discovered an exciting new species of animal. Describe, and perhaps draw, its physical characteristics in as much detail as possible. In what part of the world did you make this discovery?

Describe, along with a useful sketch, the animal's habitat and behaviour? Make up a scientific name for this latest addition to the animal kingdom that fits into Linnaeus' binomial system of naming. It would also be useful to have an everyday name for your animal.



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