Cells and Living Things (Extension)

All living things share the characteristics described in MRS C GREN

Biology is the study of living things. A living object is an object that carries out life functions. A non-living object is an object that has not been alive. A dead object is an object that was once alive.
All living organisms are composed of one or more cells. A cell is a small, living unit that contains all the chemicals and molecules that help support an organism's life.

Classifying objects as living or non-living

How would we know if a car or cow is living? They both move and need "feeding" to keep them going. So why is only the cow living?

All living things share the characteristics described in MRS C GREN

We use the acronym MRS C GREN to remind us living objects show ALL of the life processes, not just some, and are made up of CELLS.

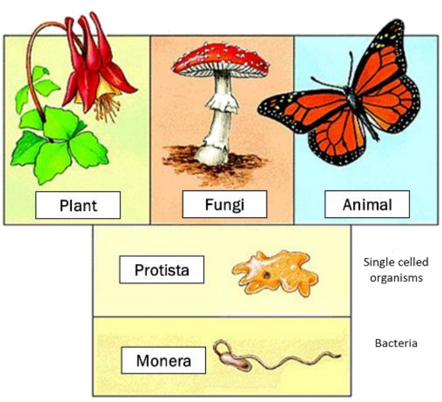
Life function	Gives us the ability to….
Movement	Move through space
Respiration	Obtain energy through reactions in cells
Sensitivity	Respond to the outside environment
Cells	Smallest unit of life – makes up the bodies of bigger organisms
Growth	Increase in size
Reproduction	Create more living things
Excretion	Dispose of waste chemicals
Nutrition	Extract useful chemicals from the environment

Living things are classified into groups based on similarities / features

Biologists classify all living things into overall groups, called Kingdoms. The members of each kingdom are alike in key ways, such as the nature of their cells, their body features or the way they obtain energy. Classification keys are used to identify living things (and other objects) in each group.

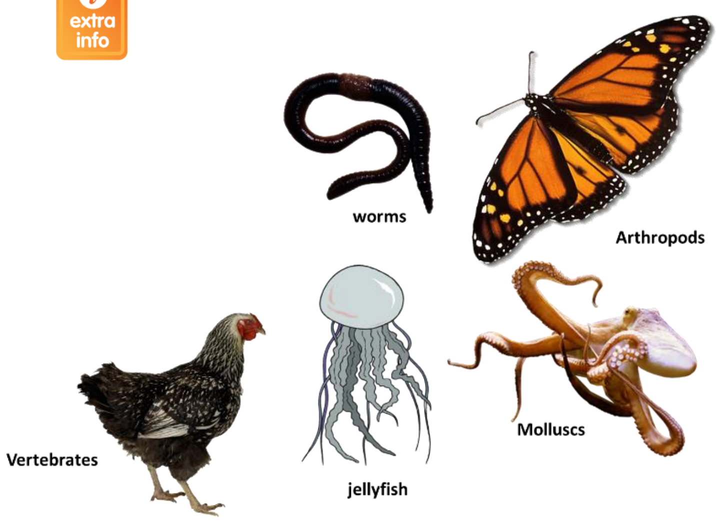
The main groups that living things are classified into; Bacteria (Monera), Protista, Animals, Plants, Fungi

Traditional classification of organisms into five kingdoms is based on differences in body structure



Vertebrates and Invertebrates

The Kingdoms have been broken down into smaller groups called Phylum. Most of the groups are invertebrates – they have no internal spine or backbone and they include the sponges, Jellyfish, worms, molluscs, Arthropods (Insects/spiders/crustaceans). One group is the Vertebrates (all animals with backbones) which we are part of.

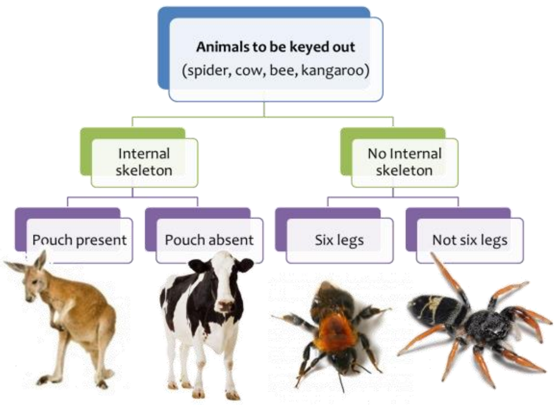


What is a dichotomous identification key?

The Dichotomous keys are used as tools to help identify unknown organisms using careful observations and matching those observations in an organised manner against choices given at each step. Each two choices are known as a couplet. Dichotomous means branched.

Rules for Using Dichotomous Keys:

1. Read both choices in a couplet (pair) carefully.
2. When reading a couplet, make sure you understand all of the terms used.
3. If you are unsure of which choice to make in a couplet, follow both forks (one at a time). After working through a couple of more couplets, it may become apparent that one fork does not fit your sample at all.
4. Work with more than one sample if possible. This will allow you to compare.
5. When a measurement is given make sure that you take the measurement and do not take a guess.



Making a simple dichotomous identification key.

If we are making a key based on observations of physical features that we can see, the first step must be a feature that can divide all of the living organisms into two groups.

For example below, we could divide the birds into those that have tuffs of feathers on their heads (spotted shag and crested penguin) and those that do not (wax-eye, brown kiwi, paradise duck, kingfisher, yellow head, spotted dotterel). Other features such as thickness of beak, tail or not, one colour or many colours – can be used to further divide each bird group.

The key is finished when each individual has its own path and the key leads to a name for each.

All living organisms are made up of cells.

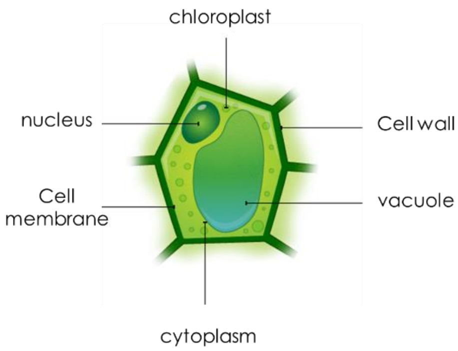
All living organisms are made up of cells, the smallest structural (how it looks) and functional (How it works) unit. Organisms can be Unicellular – consisting of one independent cell, or be multicellular – organised networks of cells with different functions and structures; humans have over 100 trillion cells.

The structure of a typical plant cell includes a cell membrane, cytoplasm, nucleus, cell wall, vacuole, and chloroplast.

Cell Wall - Gives the cell rigidity and a more angular appearance.

Chloroplasts - The site of photosynthesis, gives the cell its characteristic green colour

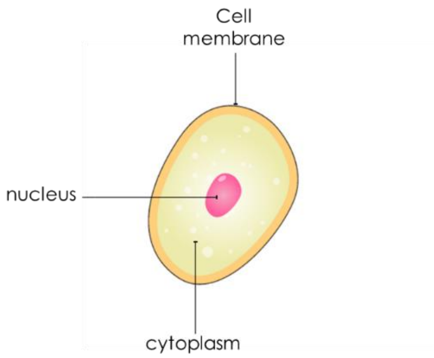
Vacuole - Assists with storage and structure



The structure of a typical animal cell includes a cell membrane, cytoplasm and nucleus

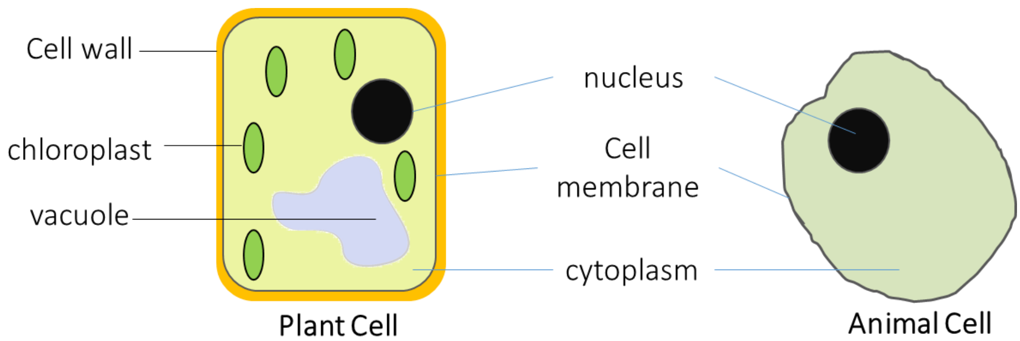
Cell membrane - Surrounds cell and controls passage of nutrients and chemicals. Flexible and allows cell to change shape.

Cytoplasm - A liquid filling the cell and containing all the chemicals the cell needs to function



Plant and animal cells similarities and differences.

Similarities	Differences
1. BOTH cells have a 'skin', called the membrane, protecting it from the outside environment. 2. BOTH cells have a nucleus. The 'information storage' of the cell. 3. BOTH cells have Cytoplasm, a fluid that protects the inside of the cell and carries nutrients	1. ONLY Plants have a cell wall that help define the shape and give structure to the plant. 2. ONLY plant cells contains chloroplasts that helps in the plants photosynthesis. 3. Plant cells are generally larger than animal cells. 4. Plants have a larger Vacuole.



Using a Microscope

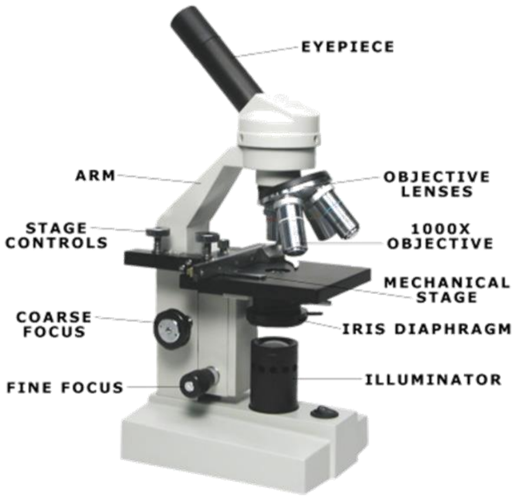
Most cells are too small to be clearly seen by eye and require a microscope to view.

Definitions:

Magnification: the number of times the image is enlarged

Resolution: the clarity (how clear) and ability to see detail in the image

Microscope parts and function



Arm - this attaches the eyepiece and body tube to the base.
Base - this supports the microscope.
Coarse focus adjustment - a knob that makes large adjustments to the focus.
Eyepiece - where you place your eye.
Fine focus adjustment - a knob that makes small adjustments to the focus (it is often smaller than the coarse focus knob).
High-power objective - a large lens with high magnifying power.
Low-power objective - a small lens with low magnifying power.
Mirror (or illuminator) - this directs light upwards onto the slide.
Stage - the platform on which a slide is placed.

Using a microscope safely

1. Make sure the lowest power objective lens (e.g. 4x) is clicked into position.

2. Place the microscope slide on the stage and fasten it with the stage clips.

3. Look at the objective lens and the stage from the side and turn the course focus knob so the stage moves upward. Move it up as far as it will go without letting the objective touch the coverslip.

4. Look through the eyepiece and move the course focus knob down until the image comes into focus.

5. Adjust the mirror for the greatest amount of light.

6. Use the fine focus knob for the clearest image

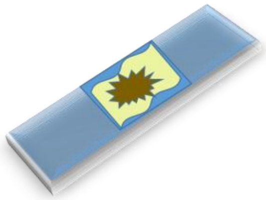
7. When you have a clear image of your sample with the lowest power objective, you can change to the next objective lenses. You might need to readjust the sample into focus

8. When finished, lower the stage, click the low power lens into position and remove the slide

Making a Microscope Slide

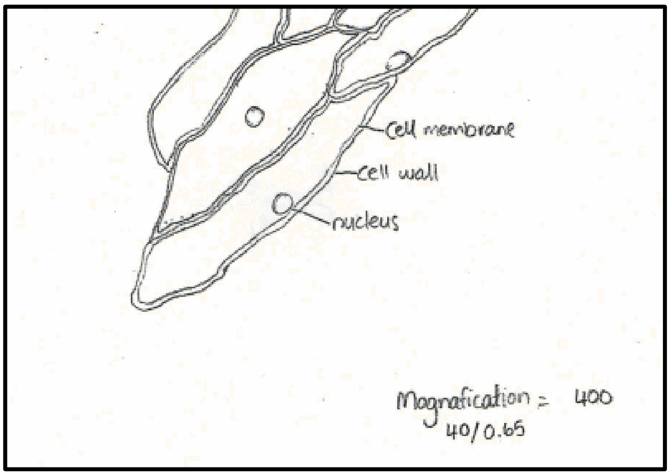
Onion Cell Slides

1. Collect onion, slide and cover slip, lamp and microscope.
2. Peel the epidermal cells (skin between layers) from the onion tissue.
3. Place the cell sample on your slide – spread it out and make sure it is not folded.
4. Add 2 drops of iodine (or other stain) to the onion slide.
5. Lower cover slip onto the slide one side at a time so there are no bubbles
6. Focus under the microscope – remember to start with low power!!
7. Draw 2-3 cells about 10 lines big into your books.
8. Return used slides and slips to the ice cream container with disinfectant.



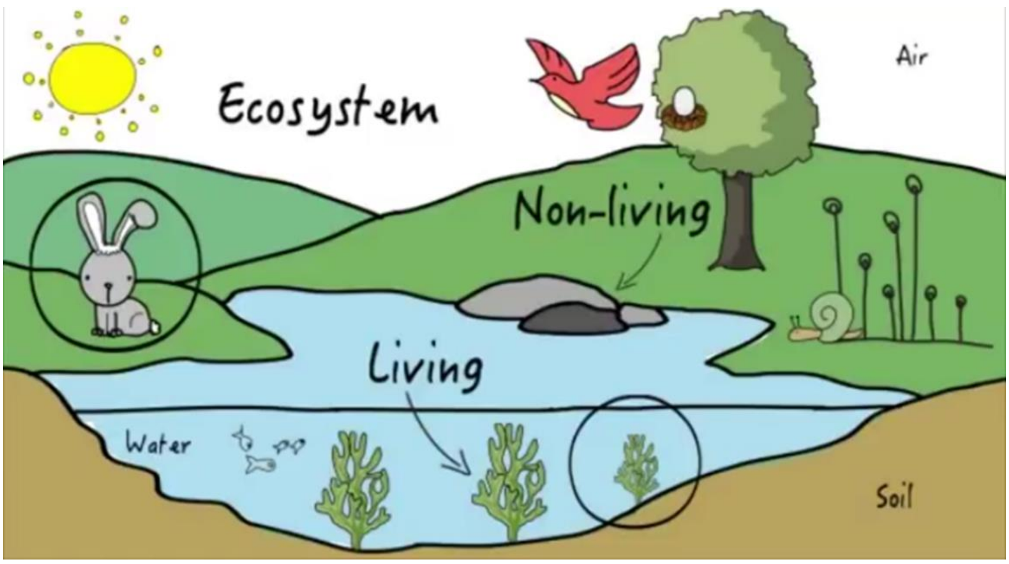
Biological drawings are a useful way of recording information from your observations.

Rules for drawing a cell
1. Use unlined paper.
2. Draw in pencil.
3. Always print.
4. Give the drawing a title
5. Use a large area of the paper
6. Label all visible parts and never cross lines.
7. Name the specimen
8. Print your name and other Information such as scale or magnification used on the microscope



An ecosystem is the habitat and the community considered together.

An ecosystem includes all of the living organisms in a specific area. These systems consist of a living part called the community made up of all the plants and animals, which interact with their non-living environments (weather, Earth, Sun, soil, atmosphere) which determine the habitats available.



The niche is the way in which an organism interacts with its environment including its feeding role, type of activity and habitat

The niche of a species describes how members “make a living” in the environment in which they are found. Describing the niche of a species would include:

- ❑ The habitat, which means where the species lives, feeds and reproduces.
- ❑ When the organism is active (day or night)
- ❑ The feeding role that the species has in the community. (producer, consumer or decomposer)
- ❑ The adaptations the organism has to best survive.

Habitat examples

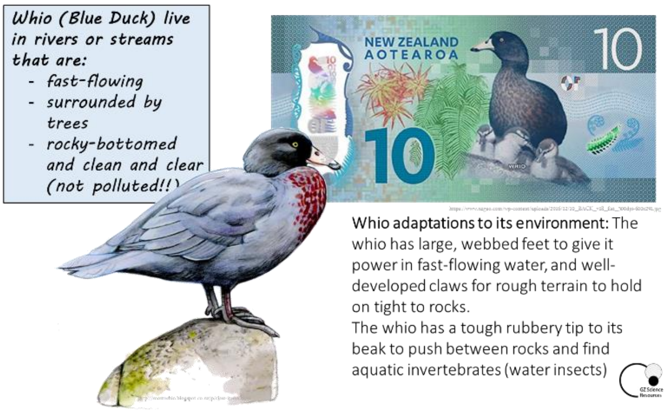
All birds form a separate group of animals that evolved from the same ancestor. Bird species are found all across the world in many different habitats. Diversity in a bird adaptations help each type of species survive in different habitats.


A NZ Keas habitat is in South Island alpine regions


Emperor penguins found only in the Antarctic polar region

Adaptations assist an organism to survive in an ecosystem

An adaptation is a feature of an organism that aids the survival and reproduction of individuals of that species in its environment.



Whio adaptations to its environment: The whio has large, webbed feet to give it power in fast-flowing water, and well-developed claws for rough terrain to hold on tight to rocks.
The whio has a tough rubbery tip to its beak to push between rocks and find aquatic invertebrates (water insects)

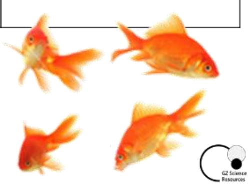
Adaptations are genetically inherited traits that allow species to survive better in their habitat

Adaptations can be classified into three main group. Structural adaptations are often seen as physical characteristics but all three types are genetically inherited and controlled by genes.

Extension

Structural	Physiological	Behavioural
A structure/physical feature of an organism that helps it to successfully live in it’s habitat. e.g.: the long beak of a kiwi to get food in the soft forest ground	A chemical or process inside an organism that helps it survive. e.g.: bad tasting chemicals inside beetles to stop being eaten	An activity that an organism does that helps it (or its group) to survive. e.g.: fish swimming in groups for safety





Organisms vary and that some variations give advantages over others in a given environment

Individuals of a species occupy a niche and they have adaptations to survive in their habitats. The adaptations may help them to best obtain food, seek mates, raise offspring, find shelter or escape predators.

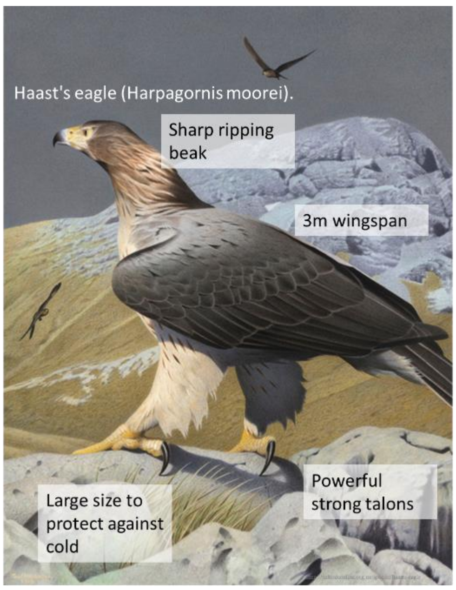
Adaptations are physical characteristics (phenotypes) an organism can genetically pass onto their offspring. Because there is variation between individuals of a species, some individuals may have an advantage over others when one or more of their adaptations is better suited for survival in their habitat.

Predator and Prey Adaptations

Predators hunt, catch and eat other animals. The animals they hunt are known as prey. Many animals can also be both – the predator of one type of animal but the prey for another species. Both predator and prey have evolved adaptations to help them survive in their habitat. The predator species has adaptations to help it better catch prey, and the prey species has adaptations to help it better avoid being eaten. The best hunters and the best escapers go on to have the most offspring.

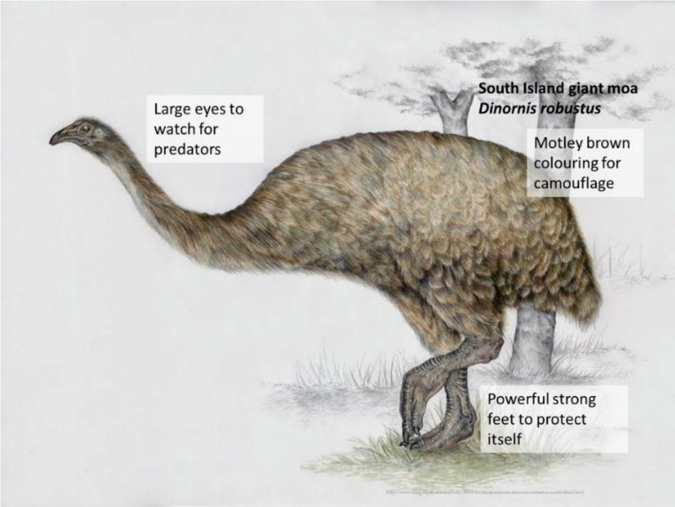
In New Zealand in the past, we did not have any Mammal predators but we did have a very large predator bird called the Haast's eagle. Sadly, this giant eagle is now extinct, and we are not entirely sure what colour the feathers were but the bird was a terrifying sight for species of Moa (also extinct) that was its prey.

Predator adaptations - Haast's eagle



Haast's eagle is the largest, heaviest eagle species that has ever lived, weighing up to 18 kg and had a wingspan up to 3 metres. The Eagle was the predator of moa such as the South Island giant moa that was nearly 4 m and over 10 times the eagle's weight. The Eagle dived on its moa prey from a high spot and killed moa by flying into their hindquarters and grappling the moa with its large feet and talons, which were stronger than a tigers, before crushing the Moa's skull. Haast's eagle became extinct 500-600 years ago, around the same time that New Zealand's moa species, its food sources, became extinct.

Prey adaptations - South Island Giant Moa



The South Island Giant Moa was a main prey species for Haast's Eagle. It was a herbivore, browsing and eating small shrubs, plants and berries. The Eagle needed light to hunt so the moa may have done much of its eating early morning or dusk when it was darker. The large feet could help defend it and long legs to help it run for cover. It also had a very good sense of smell.

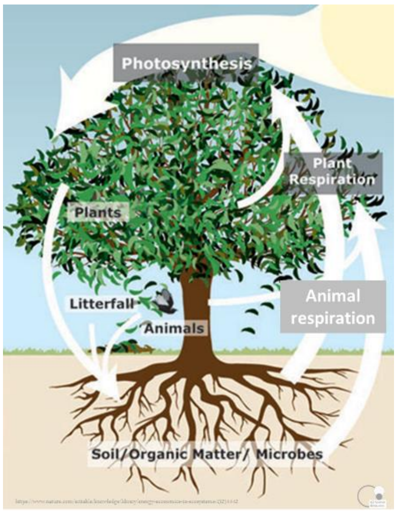
Extension

Plants fill the role of Producers in a community

Plants are special because they have leaves and are able to produce their own food by the process of photosynthesis from sunlight using raw materials that they get from the air and soil.

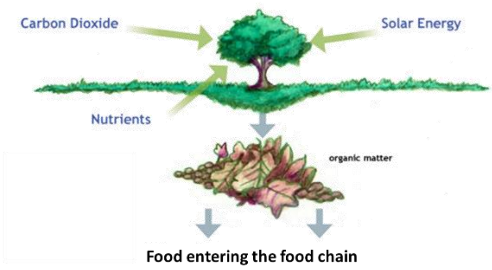
Plants can be thought of as 'food factories' which provide most living organisms on Earth with a source of energy and food. They produce the energy that is at the start of any food chain and therefore the group of plants are known as Producers.

Community – a group of different species living together and interacting



The importance of plants as producers.

Producers are at the beginning of a food chain. On land, Producers are plants. Plants are at the beginning of every food chain that involves the Sun. All energy comes from the Sun and plants make food with that energy using the process of photosynthesis. Energy in the form of nutrients and food are passed onto other organisms when they eat (consume) the plants.



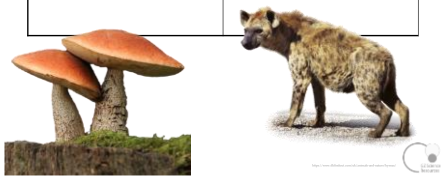
The role of producers, consumers and decomposers in food chains and webs.

The two main groups that organisms can be divided into as feeding groups are either producers or consumers. Consumers can then be further dived into decomposers, herbivore, carnivores, omnivores and scavengers.

Producers	Consumers
Organisms that make their own food through photosynthesis, such as plants	Organisms that need to eat other organisms for food, such as animals

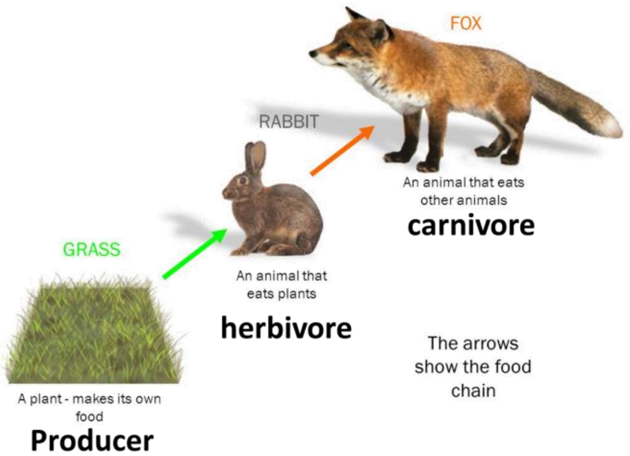
Herbivores	Omnivores	Carnivores
Herbivores are animals that eat plants only. (plant eaters) In a food web they are directly above the producers	Omnivores eat both plants and other consumers. They obtain their food from more than one source.	Carnivores eat only other living consumers (meat eaters). This also includes birds that eat only insects.

Decomposer	Scavenger
Fungi and bacteria that break down the bodies of dead plants and animals	Consumers that eat dead animals



The role of producers in food chains.

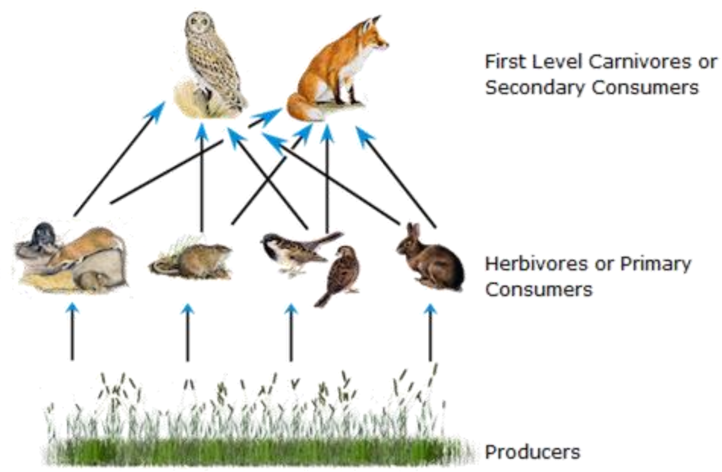
A food chain is a series of organisms through which energy flows; first link is always a producer, such as a plant. The producer stores energy from the Sun through the process of photosynthesis. Each organism above the producer eats the one below it in the chain. Energy flows in one direction only.



Food Webs

In an ecosystem, there are many different food chains and many of these are cross-linked to form a food web. Ultimately, all plants and animals in an ecosystem are part of this complex food web.

If one species in the food web changes in numbers, it will affect all other species in the food web. For example, if all the rabbits were removed the predators would need to start eating more of the birds, mice and rats. The grass that the rabbits ate would increase and feed more of the other herbivores.



Energy enters an ecosystem in sunlight, which is transferred to energy in plants by photosynthesis and that this energy is then passed along food chains.

Trophic levels are the feeding positions in a food chain such as primary producers, herbivore, primary carnivore, etc. Green plants and phytoplankton form the first trophic level, the producers. Herbivores form the second trophic level, while carnivores form the third and even the fourth trophic levels, all called the consumers.

Energy is passed from one trophic level to another starting from the producers. Food webs and food chains are used to show which species of organism is at each level and how energy moves between them.

New Zealand plants and animals are unique due to them evolving in geographical isolation

For a long time in New Zealand's geographical history it formed part of a land mass called Gondwana, also composed of Australia, and Antarctica (as well as Africa, South America and India at an earlier stage). About 85 million years ago the plate that New Zealand sat on top of broke away from Gondwana and moved North, through the process of plate tectonics, and has remained in isolation ever since.

85 Million Years Ago | 60 Million Years Ago | Today

Ancestors of New Zealand's plants and animals arrived at various times in the past

When New Zealand first broke away from Gondwana it was in the form of a giant land mass called Zealandia and populated with animals and plants - all of which had previously evolved on Gondwana. Zealandia sat upon a thin crust and over time scientists believe it almost completely (if not entirely) submerged. Parts of it that we now recognise as New Zealand were raised up from the ocean due to active plate movement under it about 30 million years ago. It was after this time that birds, insects, reptiles and plants that either flew or rafted over from Australia or South America populated New Zealand

New Zealand's Plants and Animals have had to adapt to its constantly changing conditions

Ever since New Zealand broke away from Gondwana, it has had a very disruptive geographical history. At various times in its past New Zealand has been totally (or almost completely) submerged under the ocean, encountered a series of ice ages which covered the country in ice, snow and glaciers as well as had ranges of mountains pushed up due to tectonic plate movement and eroded back down again. During this time New Zealand's animal and plant species have had to adapt and evolve to these changing conditions, some becoming extinct but others remaining to the present time.

New Zealand's first arrivals

From the original pioneers that populated New Zealand after it re-emerged from the sea we now have animals such as tuatara, kākāpō, wrens, moa, primitive frogs, geckos, dinosaurs, primitive groups of insects, spiders and earthworms as well as some types of plants - all of which had evolved and changed in time from their ancestors.

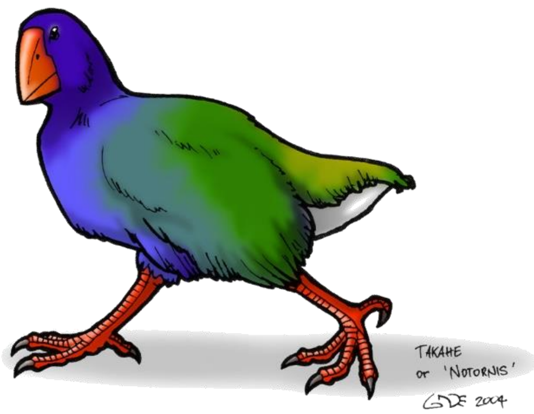
Other species of animals either flew across large distances from surrounding countries or were transported across by the sea at various times in the next 25 million years but no species of Mammal (aside from two species of bat that flew) ever made it across to New Zealand until Humans arrived around 700 years ago.

New Zealand’s plants and animals have evolved in the absence of Mammals

New Zealand’s animals have evolved without the presence of Mammals and any ground predators. This has created some special characteristic features in our animals. Many of our bird species have become flightless because they have not needed to fly away from predators. Niches or lifestyles filled by Mammals in other countries have been filled by birds, insects and reptiles in New Zealand.

For example the kiwi occupies a niche similar to a badger - lives in burrows, eats worms and other invertebrates (animals without an inside skeleton) , the Moa occupied a browsing niche similar to deer, Weta and the Short tailed bat occupied a niche that is taken up by mice elsewhere.

Because of this, many of our species look quite different from related groups of animals and plants in other countries.



What is the advantage of not flying?

Flight in birds is an adaptation to escape from predators and move around quickly. It requires a lot of energy, which means birds who fly, must find and eat a lot more food than non-flying birds. Birds who fly also need to be light so their size and weight is limited.

New Zealand had no mammal predators so birds did not need to fly to escape. The benefits of not flying out weigh those of flying. Birds that did not fly had a survival advantage over those that did and produced more offspring. New Zealand flightless bird species could also become heavier and be suitable for niches (jobs) that were occupied by mammals in other areas of the world.

Endemic or native?

New Zealand has a large number of endemic plants and animals – that means not only are they found in New Zealand (native) but they are also found in no other place. There many thousands of fungi and insect species that are endemic plus around 70 birds, 80 skinks and geckos, 38 freshwater fish, four frogs, three bats and two species of tuatara.

New Zealand Birds

New Zealand has many different types of habitats ranging from mountains to forest to coast and marine. All of these habitats have bird species which live, feed and breed in them.

Since humans have lived in New Zealand, for at least the past 700 years, introduced mammal pests and habitat destruction have reduced the numbers of these birds. Some like the *Huia* and *Moa* have become extinct. Others like the *kakapo* and the *black robin* have been saved from extinction but have a very small population.

We are now realising how important it is to protect the habitats and the birds that we still have left to stop more being lost forever.

http://www.katesutton.co.uk/#/birdsofnewzealand/

Our unique birds - Kakapo

The Kakapo is the only flightless and nocturnal parrot in the world. The Kakapo is also the heaviest parrot in the world, weighing up to 3.5 kilograms. Due to habitat destruction and predation there are now only approximately 125 Kakapo left. These remaining birds have been relocated to several predator free island habitats, where the birds can breed in safety.

Our unique birds - Kiwi

The kiwi are a flightless, nocturnal group of birds related to the extinct Moa and the still living Emu, which form part of a group called the ratites which now live in countries once forming part of Gondwana.(Africa, Australia, South America etc.) There are five main species of Kiwi in New Zealand: the brown kiwi, the rowi, the tokoeka, the great spotted kiwi or roroa and the little spotted kiwi.

They all eat invertebrates (worms, insects etc.) and fruit. The females produce an enormous egg, which the males incubate. The chicks must survive on their own as soon as they are born.

Our unique birds - Tui

Tūī belong to the honeyeater family, which means they feed mainly on nectar from flowers of native plants such as kōwhai, pohutukawa, rātā and flax. Occasionally they will eat insects too.

Tūī are important pollinators of many native trees and will fly a long way for their favourite foods, especially during winter. Flowers that are red or yellow often indicate that a plant is pollinated by birds.

Our unique birds – New Zealand Black Robin

The New Zealand black robin all live on the Chatham Islands off the coast of New Zealand. They are an endemic species (found nowhere else in the world) and are famous for being one of the World's rarest birds at one stage.

In 1980 there were only five black robins left in the world, and only one female – Old Blue, who was thought to be too old to produce chicks. Fortunately, this was not the case and with the chicks she went on to have, there are now around 250 black robins with Old Blue being the ancestor to all of them.

Our unique birds - kōkako

The North Island kōkako, distantly related to the Tui and the extinct Huia, in found in small populations in the North Island forest. There is also a South island kōkako with orange wattles (flaps on the chin) but it is thought that that species is now extinct.

The kōkako have a unique way of moving through the forest trees by running and climbing along the branches then gliding from tree to tree. Its song is very particular and the main part of it gave the bird its name – kō – ka – ko.

Environmental changes may occur naturally or be human induced

Natural Environmental factors such as drought leading to lack of food or water, disease, flooding, volcanic activity and sudden climate change have been occurring since living organisms first appeared on Earth. In some cases, these factors have been so extreme that worldwide extinction of many species has occurred.

Environmental factors can also be caused or induced by Humans such as the climate change occurring now created in part by human pollution in the atmosphere. Cutting down trees and destroying habitats along with introducing animal and plant pests also have negative impacts on the native life.

The main threats to our native animals

What is killing our Native Animals?

- Introduced species such as rats, stoats and possums killing the birds and/or their eggs
- Introduced competing species such as rabbits and possums eating the birds food
- Human destruction of bird habitats

Our animals in New Zealand evolved in the absence of ground predators or mammals so they have not developed adaptations to defend themselves as well as other species in the rest of the world have. Our birds, that have become flightless, heavy and slow breeding, have been especially vulnerable to introduced predators. Large areas of our native forest have been burnt and cut down as well as wetlands drained to convert to farmland, since humans have arrived. Some of our endangered species are confined to small marginal areas of land.

The Kakapo case study

Kakapo were once spread all over New Zealand in large numbers before humans arrived on New Zealand. The species evolved without mammal predators. The nocturnal behaviour (active at night-time) and bush camouflage protected it from its main predator, the giant Haast eagle – that hunted in the day by sight.

The introduction of mammal pests that ate and killed kakapo as well as humans killing and eating kakapo, greatly reduced numbers of kakapo. The destruction of the habitat and food of the kakapo by humans and pests also had an impact. Kakapo have not evolved to escape predators and they cannot fly to escape. They are more sensitive to predators than birds that have evolved with them. Kakapo are slow breeding and have small numbers of chicks – they cannot replace lost birds quickly. There is low genetic variation and diversity of the remaining birds so there are less healthy chicks produced and a low breeding rate. It is harder for males to find partner to mate with and a limited habitat to live in and get enough food, especially mast Rimu required during breeding.

Maungatautari Ecological Island trust – A case study

Maungatautari is a bush-covered mountain surrounded by farmland in the Waikato. It was once the home of many New Zealand species but due to introduced predators such as rats, possums and stoats, and habitat destruction, many species became extinct and the mountain became empty. Over a decade ago, a number of farmers and conservationists came up with an ambitious idea to surround Maungatautari Mountain with predator proof fencing and begin intensive pest control to remove every single mammal pest. Not that many years later, with a huge effort from volunteers and the generosity of local landowners and Iwi, Maungatautari started to come alive once more.

The Hihi (stitchbird), takahe, Tuatara, Kiwi, saddleback and the North Island Robin are just some of the species introduced back into the safe predator free sanctuary. Many species of Reptile, plants and Fungi once thought extinct have also made a remarkable recovery as well. Maungatautari sanctuary has become Taonga (treasure) for all New Zealanders.