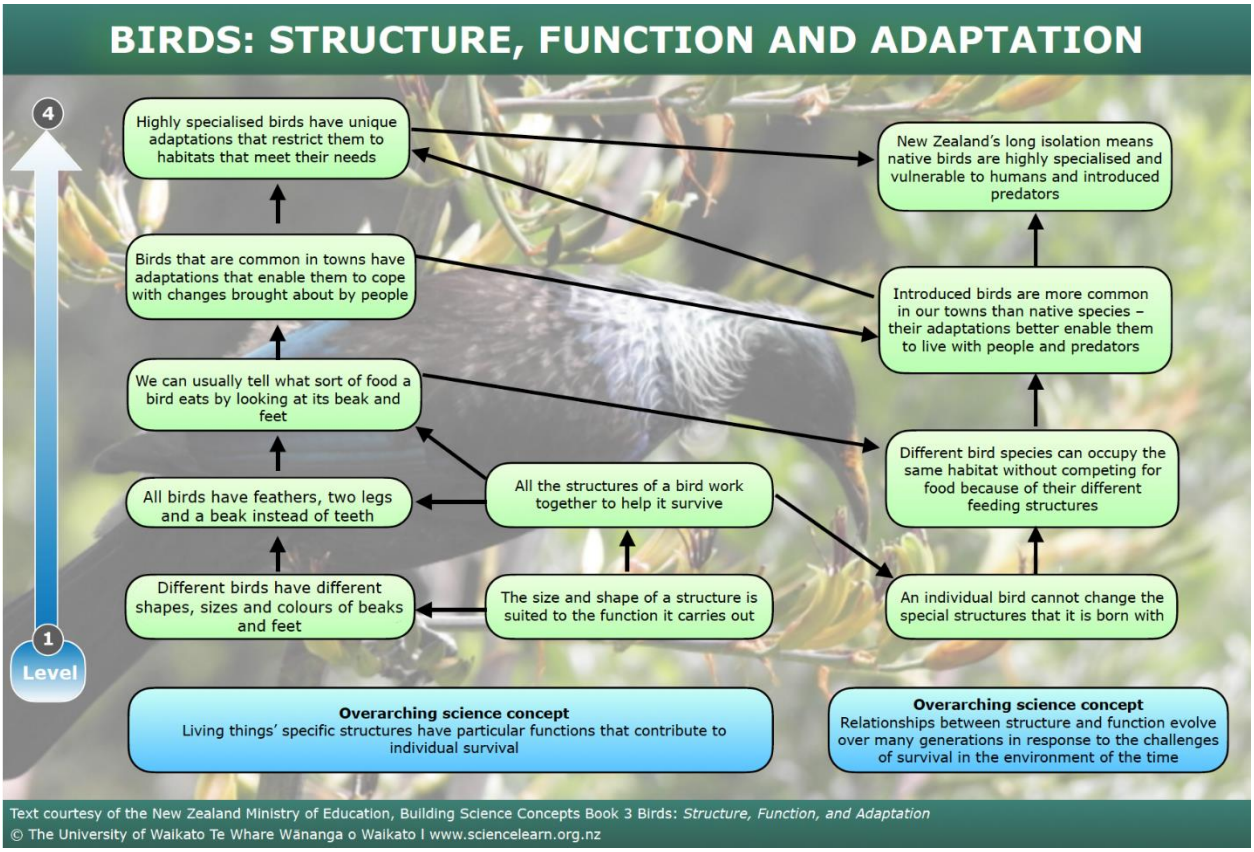
Birds: Structure, function and adaptation



This interactive diagram explores the sequential and interlinking science concepts that underpin knowledge and understanding about birds' physical features, their functions and how they help birds with flight, feeding and life in particular habitats.

The concepts listed just above the overarching concepts reflect learning at New Zealand Curriculum level 1 and show how they may build in sequence to level 4. The overarching science concepts are fully developed concepts and might not be achieved until level 7 or 8.

Some of the text is courtesy of the New Zealand Ministry of Education's Building Science Concepts Book 3 *Birds: Structure, Function, and Adaptation*. The links to Hub resources provide additional background information and classroom activities that will support teachers to scaffold the development of their students' conceptual understanding about birds. The images provide a means to initiate discussions, check student thinking and consolidate student understanding.

The article Building Science Concepts: Birds provides additional science and pedagogical information.

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- Introduced birds are more common in our towns than native species – their adaptations better enable them to live with people and predators
- Different bird species can occupy the same habitat without competing for food because of their different feeding structures
- An individual bird cannot change the special structures that it is born with

Highly specialised birds have unique adaptations that restrict them to habitats that meet their needs

Takahē in Fiordland, © Sam Haultain

The fantail – with its varied diet of flying insects, its treetop nests, and its acrobatic flying skills – has adapted to survive in the presence of people.

By contrast, the kākāpō is restricted to the forest. Kākāpō cannot fly, lays eggs very infrequently and has a freezing response to danger, which is ineffective against introduced predators. Kākāpō are endangered.

Takahē adaptations enable them to live in harsh alpine habitats, where they were able to avoid introduced predators for decades.

Related articles
- Endemic, native or introduced birds
- Predation of native birds
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- The takahē's ecological niche
- Conserving native birds – introduction

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- Whio habitats and conservation
- Conserving native birds – unit plan
- Abiotic and biotic factors for takahē (for levels 6 and above)

Birds that are common in towns have adaptations that enable them to cope with changes brought about by people

Common blackbird, © Andreas Trepte, CC BY SA 2.5

Birds such as gulls and blackbirds have developed such a diverse diet that they can inhabit a wide range of environments. The blackbird is a recent immigrant with a variety of adaptations that suit it to a wide range of environments. It can be found in places as diverse as towns, cities, orchards, farms and remote forests, from the sea to mountaintops.

Its short, pointed beak is ideal for eating many kinds of berries and fruit and for flicking away leaves in search of insects and worms. This wide and omnivorous diet means that the blackbird can avoid competition with other species for the same foods. The blackbird nests in trees out of the reach of predators and can lay eight eggs a year. During nesting and fledging of its young, it is fiercely territorial – a behavioural adaptation that has the effect of protecting food supplies. Birds with a narrow diet must live within a more limited range.

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- New Zealand Garden Bird Survey – citizen science project
- Birds in my backyard
- Conserving native birds – unit plan

We can usually tell what sort of food a bird eats by looking at its beak and feet

Kākā eating a pūriri moth, image courtesy of Ngā Manu Images

Birds have a range of easily observable structural and behavioural adaptations that give clues to their different foods and lifestyles.

The kaka uses its strong beak to remove strips of bark from trees, looking for insects and tree sap. The kaka has a brush tongue to lick sap that oozes from the cuts it makes.

The whio has rubbery soft flaps on the end of its bill to help scrape its food off the surfaces of rocks. Look closely at this image and you'll also see the sieve-like structures inside the bill. It uses these to sieve larvae and insects.

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- The takahē's ecological niche

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- Male bellbird feeding
- Oystercatcher
- Takahē beak

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All birds have feathers, two legs and a beak instead of teeth

Whio with ducklings, © Bubs Smith

These are the basic structures that define these animals as birds.

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- How birds fly
- Feathers and flight
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- Penguins
- Whio feathers
- A banded kākā

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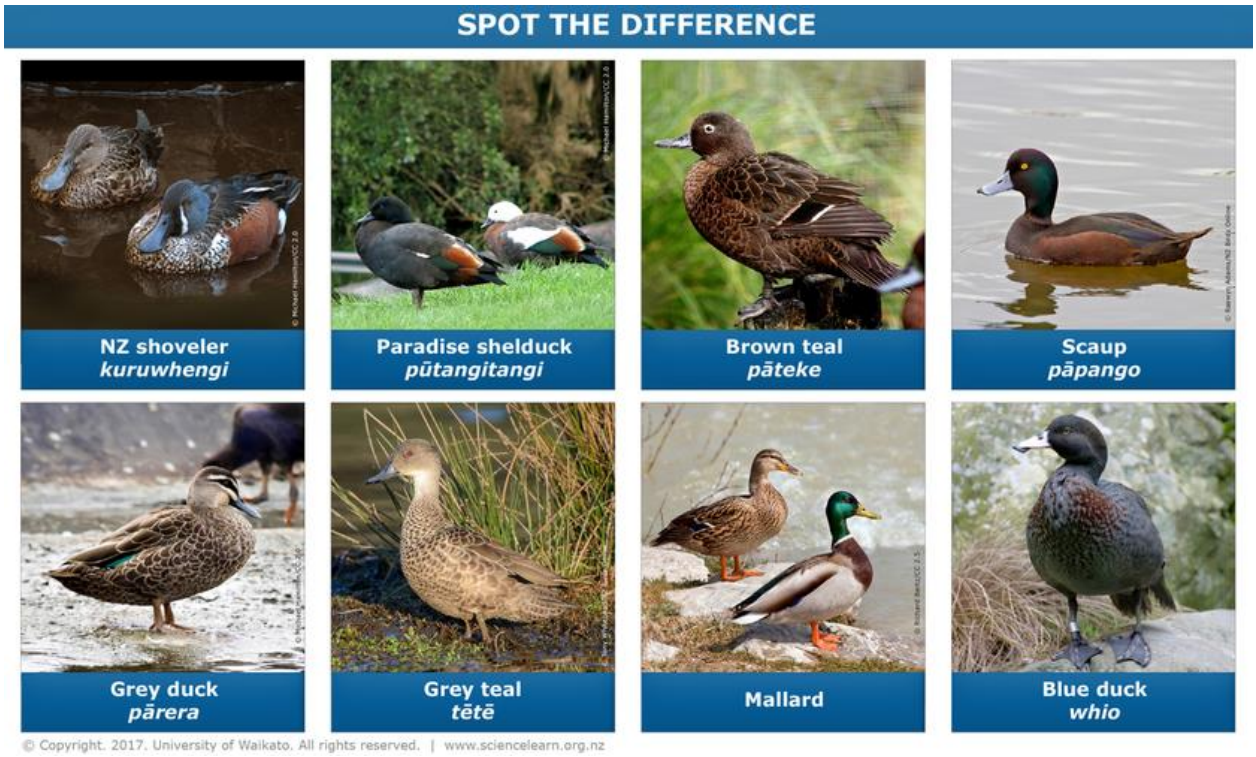
Different birds have different shapes, sizes and colours of beaks and feet



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When we investigate different sizes, shapes or colours in structures such as birds' beaks, feathers, wings or feet, we are studying physical adaptations.

These adaptations take many centuries to develop, so the kiwi couldn't suddenly grow wings and relearn how to fly.

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- How birds fly
- Native bird adaptations
-

Related images
- Native birds as pollinators – beak
- Takahē beak – beak
- Kākā feeding on sap – beak
- North Island brown kiwi – beak
- Penguins – feathers
- Whio feathers – feathers

Related activities
- Classifying bird adaptations
- New Zealand Garden Bird Survey – citizen science project

All the structures of a bird work together to help it survive

© Associate Professor Phil Battley, Massey University

Birds' hearts, lungs, bones, beaks and even their reproductive organs have a range of adaptations to help them survive.

For example, before their huge migratory flight, godwits put on a lot of weight under the skin, around their intestines, stomach and gizzard and even their heart is just packed with fat. When the godwits leave Aotearoa New Zealand, the increased fat makes it a lot harder for the bird to fly so their exercise organs – the flight muscles and the lungs and the heart – all have to be tuned up as well.

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- How birds fly
- Flight of the godwit
- Whio adaptations

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- Skeleton of North Island Takahē
- Soaring and flapping
- Insulation with feathers

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- Conserving native birds – unit plan

The size and shape of a structure is suited to the function it carries out

© *Associate Professor Phil Battley, Massey University*

Feathers are outgrowths of a bird's skin and are lightweight and yet strong enough to withstand the force of moving air while the bird is in flight. There are three main types of feathers.

Contour feathers are important to streamline a bird's overall shape, helping the air to flow smoothly over its bodyline as it flies. These feathers have a central quill or shaft, and the fine divisions of the web are held firmly together by adjacent interlocking barbs and barbules. These are like a hook and eye system holding the fine strands of the feather together.

Flight feathers are the long, very strong feathers attached to the leading edge of the wing and to the tail. Like the contour feathers, they have the barb and barbule hook system but the flight feathers have the quill closer to the leading edge rather than centred.

Insulation or down feathers are the fluffy soft feathers that keep their flight muscles warm. Keeping the muscles warm improves their performance, and the down also insulates the bird, saving it from using energy to keep warm.

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- Feathers and flight
- Fantastic whio feathers

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- Soaring and flapping
- Insulation with feathers
- Flight feathers
- Parts of a feather
- Kererū in flight

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New Zealand's long isolation means native birds are highly specialised and vulnerable to humans and introduced predators

Courtesy of Ngā Manu Images

New Zealand ecosystems have very high numbers of endemic species. These are species that are found in New Zealand and nowhere else. Aotearoa New Zealand separated from Gondwanaland around 85 million years ago. Without mammalian predators, some of the birds evolved to be ground dwellers, such as the kiwi, kākāpō and weka. With the arrival of humans around 700 years ago came new predators. These predators with their food and habitat requirements wrought huge changes on our unique and fragile ecosystems. Since the arrival of humans until 1994, 46% of the endemic land, freshwater and coastal bird species have become extinct.

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- Conserving native birds – introduction
- Endemic, native or introduced birds
- Predation of native birds
- Protecting native birds
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- Takahē conservation efforts

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- Takahē with chick
- Pest trap
- New Zealand Threat Classification system showing native ducks
- Kākā fledglings
- Tracking tunnel
- Conservation – takahē

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- Birds in my backyard
- Bringing back the birdsong
- New Zealand bush ecosystems
- Ethics in bird conservation

Introduced birds are more common in our towns than native species – their adaptations better enable them to live with people and predators

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Adaptations change slowly and only over many, many generations. For some native birds, their adaptations actually threaten the birds' survival. Many New Zealand birds are flightless, and that combined with their slow breeding rates, small clutch sizes and large eggs are some of the factors that affect their survival. These flightless birds and large eggs are easy prey for predators. Many of New Zealand's nocturnal birds will not thrive in brightly lit urban environments.

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- Garden birds – bilingual names

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Different bird species can occupy the same habitat without competing for food because of their different feeding structures

Kererū, © Geoff de Lisle. Tūī, courtesy of Ngā Manu Images

Different bird species can occupy the same habitat without competing for food because of their different feeding structures

While tūī and kererū both feed on fruit from native trees, the kererū has the widest gape out of all New Zealand native birds. This enables it to eat the largest berries in the forest. Together, these and other birds assist in the seed dispersal process, allowing seed germination to occur.

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- Birds' roles in ecosystems
- Kererū – our native pigeon
- Introducing New Zealand ducks

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- Native birds as pollinators
- Kererū feeding on karaka berry

Related activities
- The Great Kererū Count – citizen science project
- New Zealand Garden Bird Survey – citizen science project

An individual bird cannot change the special structures that it is born with

© Rod Morris, Department of Conservation

It takes thousands or millions of years for physical adaptations to become distinct within a species. Individuals cannot adapt in this way. For example, although a long beak is useful to exploit a good food source, individual birds do not suddenly grow long beaks. Assuming that the good food source remains constant, the birds with longer beaks in the population survive best over generations, and so beaks in general get longer.

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