Movement of Animals

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MOVEMENT OF ANIMALS

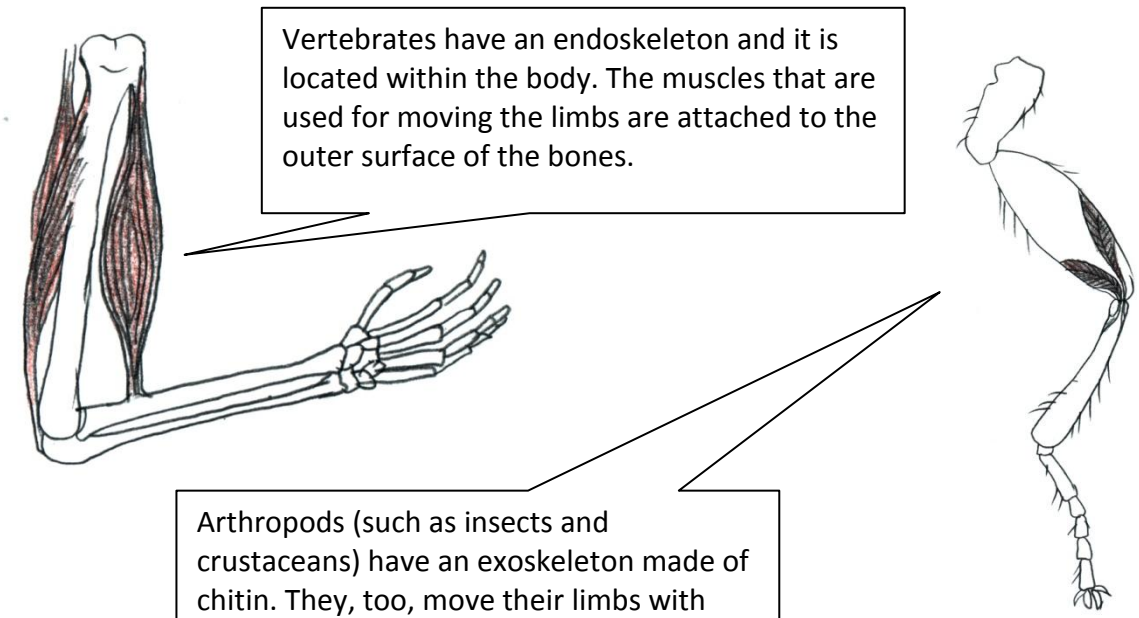
Without the ability to move, there would be no life on Earth. Moving around is essential to many animals for finding food and a mate. Even plants move, by spreading themselves with the help of seeds or sprouts. But how is moving around possible? What kinds of adaptations do different kinds of animals in different environments have, and how do they help them survive?
This small booklet will give you food for thought and provides pointers for studying nature.

WHERE AND HOW DOES MOVING AROUND TAKE PLACE?

For moving around, animals have occupied almost all places that are suitable for life: the underground soil, the surface of the ground, water and air. The varied nature of moving is indicated even by the words that we use for describing different sorts of movement: crawling, digging, walking, running, climbing, jumping, flying, jogging, dashing, sneaking, floating, gliding, trotting, galloping, and so on.

By movement we usually mean displacement from one place to another. But an animal can also simply move its body or limbs – that is, change their position. Moving the body is the foundation of moving about. Even when birds lets air currents carry them, they in fact change the position of their wings and tail, thereby changing the direction where they are travelling.

A large number of animals move around using their limbs, and the limbs are moved by muscles. The muscles are attached to either the endoskeleton or the exoskeleton.

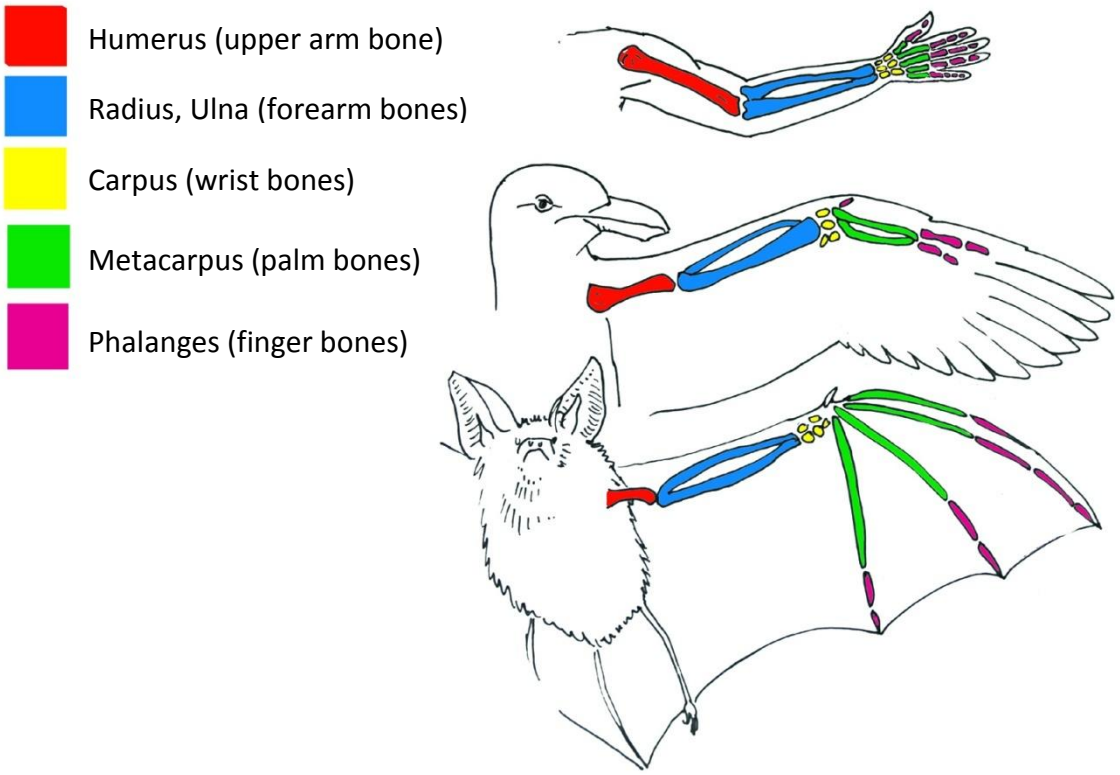


Vertebrates have an endoskeleton and it is located within the body. The muscles that are used for moving the limbs are attached to the outer surface of the bones.

Arthropods (such as insects and crustaceans) have an exoskeleton made of chitin. They, too, move their limbs with muscles, but unlike in vertebrates, the muscles are attached to the internal surface of the exoskeleton.

There are animals who do not have limbs and who move around by either changing the shape of their body, using appendages or by floating in water. These include various worms, snails, cnidarians, protozoans and others.

Whereas the wings and legs of insects have developed entirely independently, the wings of vertebrates are in fact transformed forelimbs. The wings of both bats and birds are forelimbs that have been adapted to flying.



WAYS OF MOVING IN DIFFERENT GROUPS OF ANIMALS

By observing different groups of animals, we can see a wide range of ways of moving around. Often, we can also see the degeneration of movement, with limbs getting increasingly smaller or disappearing outright.

Ctenophora (comb jellies) are invertebrate marine animals. For swimming around, they use little protrusions of the cells – cilia – and are also the largest animals to use cilia for swimming. The largest comb jellies can grow up to 1.5 metres in length.

Although **corals** live as colonies attached to the seafloor, their larvae use cilia for swimming to the surface of the water in order to develop, after which they again descend to the bottom and form a colony.

Starfishes are echinoderms, as are sea urchins and sea cucumbers. These marine animals move along the seafloor by using little limbs that protrude from the body. Movement takes place when the starfish pumps water into the limbs by turns, creating a wavelike motion in the limbs.

Annelids that live in the soil push themselves forward by contracting and extending their body muscles, using bristles on the outer surface of their bodies as “anchors”. Annelids include lugworms and earthworms. The former lives in the seafloor, the latter on dry land, in the soil.

Snails are **molluscs**. They move around by crawling along the ground, on plants or the seafloor. The underside of their body generates wave-like movements that carry them forward on the ground. Some sea snails can also swim. For this purpose they have evolved small specialized wings that they wave in order to move in water.

The cephalopods that live in the sea are also molluscs. This group includes the **octopuses**. To move around in water, they use jet propulsion, expelling water from inside their bodies. This way of moving, however, consumes a lot of energy.

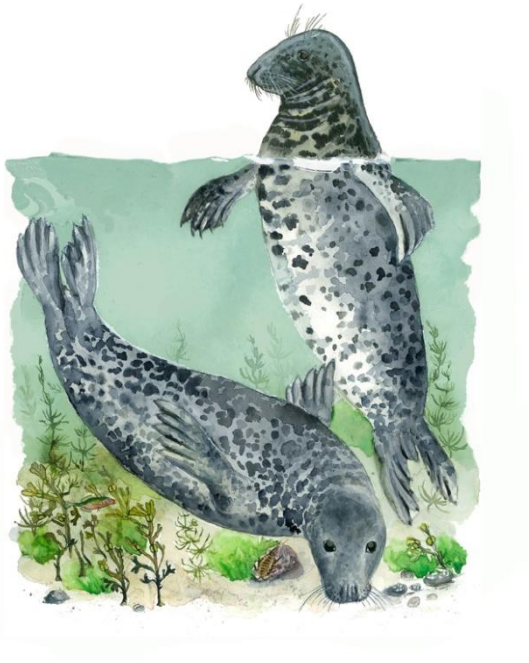
The diversity of **arthropods** is immense, both in their ways of life and in appearance. Most crustaceans live in water, where they use legs for swimming and walking. Crustaceans that move on land – such as woodlouses – also use legs for walking. But among insects, we find all kinds of ways of moving around: flying, swimming, crawling, burrowing, as well as simply walking and running. As adults, the majority of insects can fly, and they have wings. Beetles have foldable hindwings that are hidden under forewings while at rest. Many insect larvae are capable of burrowing in the soil or decaying matter. Mole crickets spend most of their lives digging tunnels in the soil, but females fly to seek for a mate. Butterfly caterpillars have prolegs with a very good grip, which they use to move on leaves and branches. Insects that swim in water use legs for swimming, such as water beetles and backswimmers, or the energy of water ejected from the body, such as dragonfly nymphs.

In **vertebrates** we can see that among the larger groups of animals there is a dominant way of moving around: **fishes** swim, **birds** fly and **mammals** move on land.
However, there are exceptions even in these groups. For example, the fish called mudskipper can use its fins to move on dry land and is capable of breathing through its skin; the sailfish can travel short distances by gliding above the water; and some fishes, such as moray eels, dig themselves into the seafloor.

There are also flightless species birds, such as cassowaries, emus and ostriches. Many birds are capable of diving under water to catch fish.

Although most mammals live on dry land, there are exceptions even here: whales spend their entire lives swimming in water, the main way of locomotion for bats is flying, and moles dig tunnels underground.

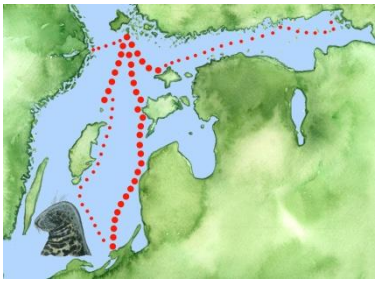
MOVING IN WATER



The mammals that live in water have a streamlined body. Grey Seals swim around using flippers, and on land they move rather clumsily. Moving in water, seals push themselves forward using their hind flippers, and use the front flippers for steering. As the seal glides in the water, the front flippers are pressed against the body.

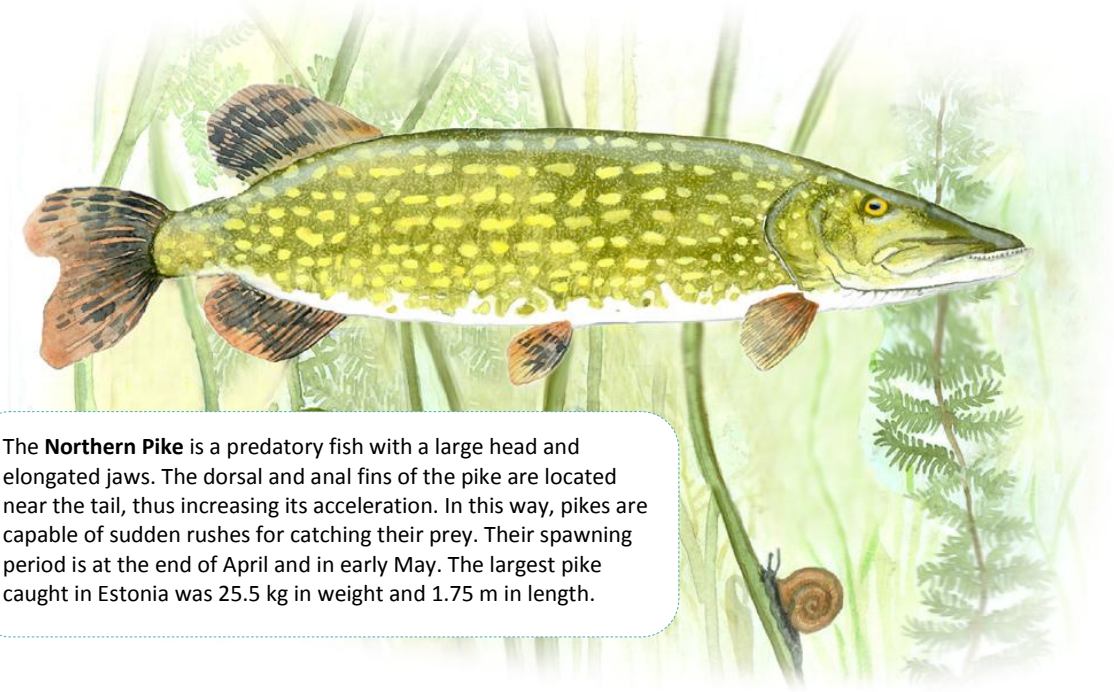
Grey Seals feed on fish. Their main diet consists of herring, European whitefish and sprat, but they also feed on carp, eelpouts, flatfishes and salmon. A Grey Seal eats about 7 kg of fish every day. Grey Seals weigh up to 300 kg and are 1.5-2.5 metres in length. The head of the Grey Seal has a longer snout than the Ringed Seal, who is smaller and also lives in the Baltic Sea.

To explore the movement and behaviour of **Grey Seals**, a device is used that relays information about their location through satellite and mobile connection. This device, the size of a soap box, is glued to the hairs of the seal. Grey Seals are great travellers, they move freely about the entire Baltic Sea. Seals marked in Estonian waters have been found from a wide area between the Åland islands and the Danish straits.



The journey of a male Grey Seal, marked on the southern shore of Saaremaa, over the course of three-quarters of a year.

Freshwater mammals, such as otters and beavers have webbing between their toes, and swimming is also assisted by the tail. The **European Beaver** (*see drawing*), our largest rodent, eats vegetative food. It fells down trees and uses their branches and trunks to construct dams and lodges on the water. The **European Otter** is a predator who mostly feeds on fish and slugs.



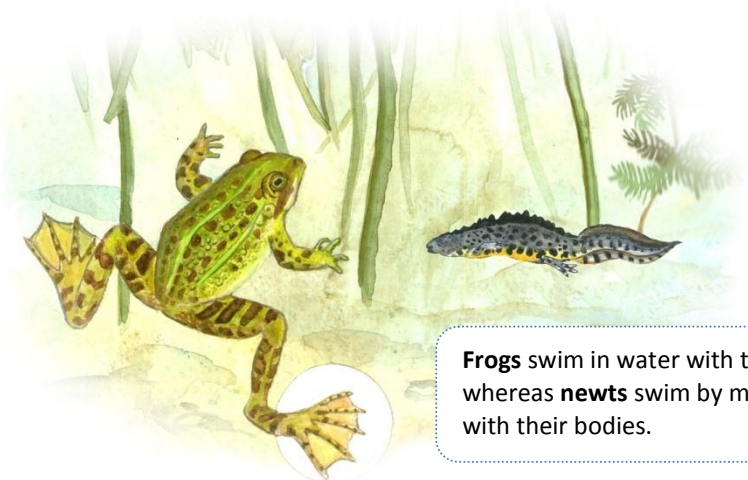
The **Northern Pike** is a predatory fish with a large head and elongated jaws. The dorsal and anal fins of the pike are located near the tail, thus increasing its acceleration. In this way, pikes are capable of sudden rushes for catching their prey. Their spawning period is at the end of April and in early May. The largest pike caught in Estonia was 25.5 kg in weight and 1.75 m in length.

Fishes have adapted to life in water. Fishes swim by moving their bodies and the tail area, with the work of the tail fin being especially important. Fins allow the fish to move, to keep balance and to turn. Fish keep their balance with pelvic and pectoral fins. The scale-covered, streamlined body is slimy, which helps them swim faster.

For moving up and down, and for keeping to a particular depth, fish use a gas-filled swim bladder. By changing the volume of the bladder, fish can descend deeper or rise up, closer to the water's surface. When descending from the surface to the depth of 10 metres, the volume of the swim bladder decreases by half.

For detecting vibrations in water, fish also have the lateral line organ.

The body of the **European Perch** is green-striped, and the fins are made of sharp bony spines and leathery membranes.



Frogs swim in water with thrusts of their hindlegs, whereas **newts** swim by making wavelike motions with their bodies.

Backswimmer

The hindlegs of **water beetles and water boatmen** are covered with rows of bristles that work as oars, enabling them to move forward quickly in water. The **backswimmer** and the **great diving beetle** are active predators that catch smaller aquatic animals. The backswimmer, an insect with a round back and a cylindrical, streamlined body swims actively with its back towards the bottom. Similar to water beetles, the backswimmer breathes oxygen from the air, renewing its supply of air on the surface. The specific gravity of the backswimmer is very low, because air sticks to the small hairs on its body.

The gerridae or water striders glide along the water surface. The limbs of water striders are densely covered with tiny hairs, and because of the air in between the hairs the legs do not wet and thus the insect can stand on water. One can also observe small springtails bouncing on the water surface, as well as the fast-moving whirligig beetles.

Water strider

Copepod

Water flea

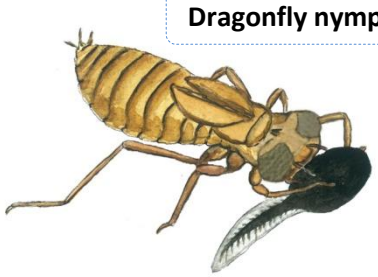
Seed shrimp

Many of the microscopic and tiny plankton animals move around using cilia, tiny hairs or other appendages. For example, the water flea moves by periodically thrusting its second set of antennae. Copepods (such as cyclopoids) use long antennae to float in water. These animals move in rapid jumps, pushing themselves forward with a coordinated movement of front antennae, thoracic appendages and the abdomen. The seed shrimp swim steadily, using the power of their antennae.

Clams are animals that live at the bottom of various bodies of water. The **river mussel** lives half-buried in the mud, filtering water. River mussels move slowly along the bottom, using a foot that extends out from between the valves, leaving behind a trail.

River mussel

Dragonfly nymph



From among **insects**, the **larvae of water beetles and dragonfly nymphs** also live in water, walking along the bottom of the water and climb on plants, occasionally swimming around as well. Dragonfly nymphs are capable of quick darts, expelling water from their abdomen.

Leeches move around in water with twisting motions of the body, or by attaching themselves to plants and rocks using suckers.

The anatomy and behaviour of **water birds** have adapted to a life connected to water. The food of water birds is usually located underwater. In order to retrieve fish, aquatic invertebrates and aquatic plants, they must dive.
Some birds with sufficiently long necks, such as the **swan**, do not have to submerge themselves entirely. It is sufficient if they just dip their heads underwater. Other birds, such as the **Tufted Duck**, must dive entirely underwater in order to retrieve their food. **Birds of prey**, who fly around in search of fish swimming near the water surface, never submerge themselves entirely, but only land temporarily on top of the water, grasp the fish and fly on. Some birds can take wing from a standstill (wild ducks), some need a longer run-up (swans, grebes).

Tufted Ducks dives to the depth of 2-3 metres and catches snails, clams and other aquatic invertebrates.

Arctic Terns are skilled fliers and catch their prey from near the surface of the water with a quick dashing flight.

Mute Swans inhabit shallow bodies of water rich in vegetation. They feed on plants, searching for them by thrusting their heads underwater in shallow waters.

The long feet and long toes of **Grey Herons** have adapted to wading in water.

The feet of **Great Crested Grebes** help them move quickly underwater. Thrusting their feet out, the leaf-shaped webs spread out, providing maximum surface for thrust. Moving their feet back, the webs cling to the toes, minimising resistance. The legs of great crested grebes are located at the back of their bodies, which is also an excellent adaptation for fast underwater swimming.

The feet of **Common Moorhen** have adapted to moving on aquatic plants and in dense vegetation. Long and spread out toes provide firm support on vegetation covering the water surface. When walking in red beds, they crook up their toes whenever they lift their feet, to prevent them from getting stuck between stalks.

The feet of **seagulls** also have broad webs. They use them for swimming on the water surface.

Ospreys hunt for fish by flying above the water surface. The long talons and the special backward-pointing digit help in grabbing and holding on to slippery fish.

EXERCISES

1. How and with what do animals move in water? Connect the correct pairs with a line.

backswimmer	thrusting with hindlegs
pike	crawling on a muscular foot
great pond snail	using flippers
leeches	body movement and fins
frogs	using suckers
seal	hair-covered swimming appendages

2. Find differences in how swans and tufted ducks move: in feeding and in taking flight.

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3. On the shore of a pond or a lake, observe the movement of aquatic animals (water beetles, fish, larvae of mosquitoes, snail, frog, duck). Describe what you saw. For observation, place smaller animals into a water-filled, transparent container.

4. On the shore of a river, pond, lake or sea, observe two species of water birds, such as swans, ducks, gulls, great crested grebes. Describe and compare their movements for acquiring food, flying and swimming.

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5. Compare the anatomy and movement of two fish. Draw the fish, taking into account the shape of the body and the shape and placement of the fins. Write down the names of the fins. Describe how the fish move.

Drawing	**Drawing**
Name of the fish:	**Name of the fish:**
How does it move:	**How does it move:**

6. Pretend to be a water bird and attempt to acquire food from the bottom of a pond using a „beak“. Fill a jar with water and place five stones at the bottom. Take a pair of tweezers or two sticks and try to remove the stones from the jar. Make a competition – who can retrieve the stones the fastest?

MOVING ON EARTH

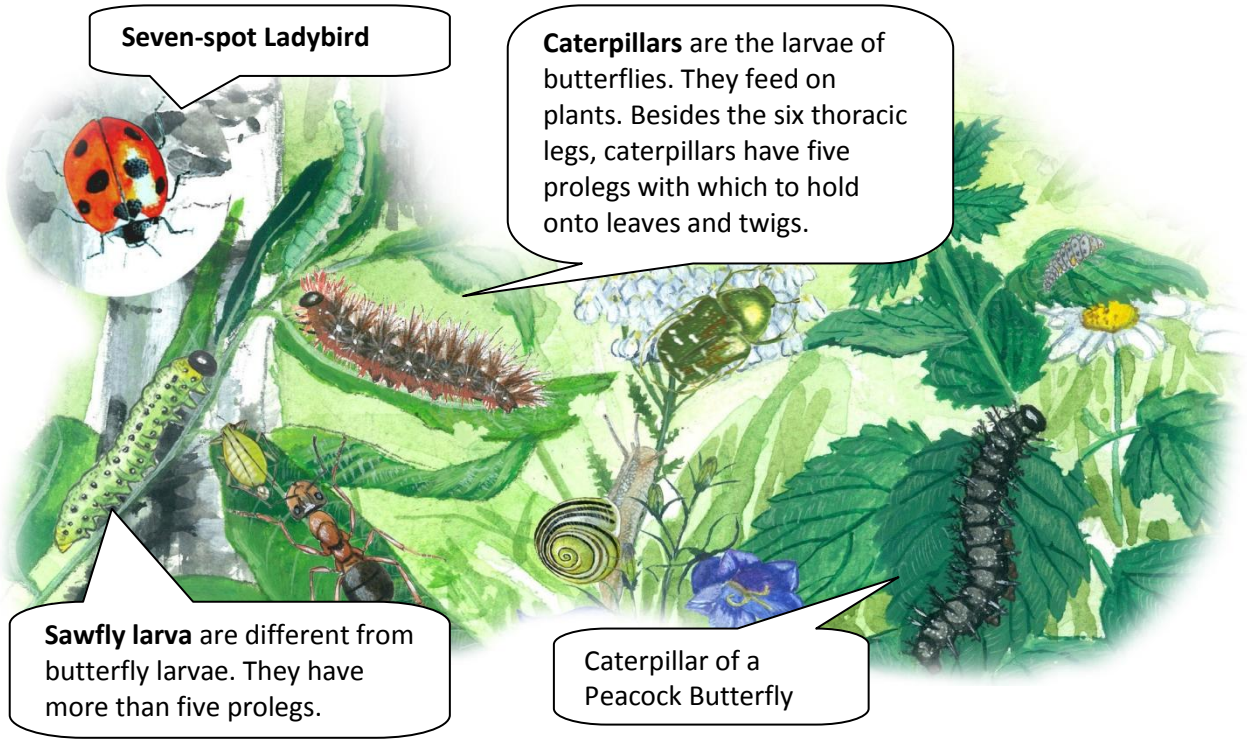
CRAWLING
White-lipped Snail
The snail moves with its single muscular foot. To aid in movement, slime is secreted from the sole of the foot, leaving behind a trace.

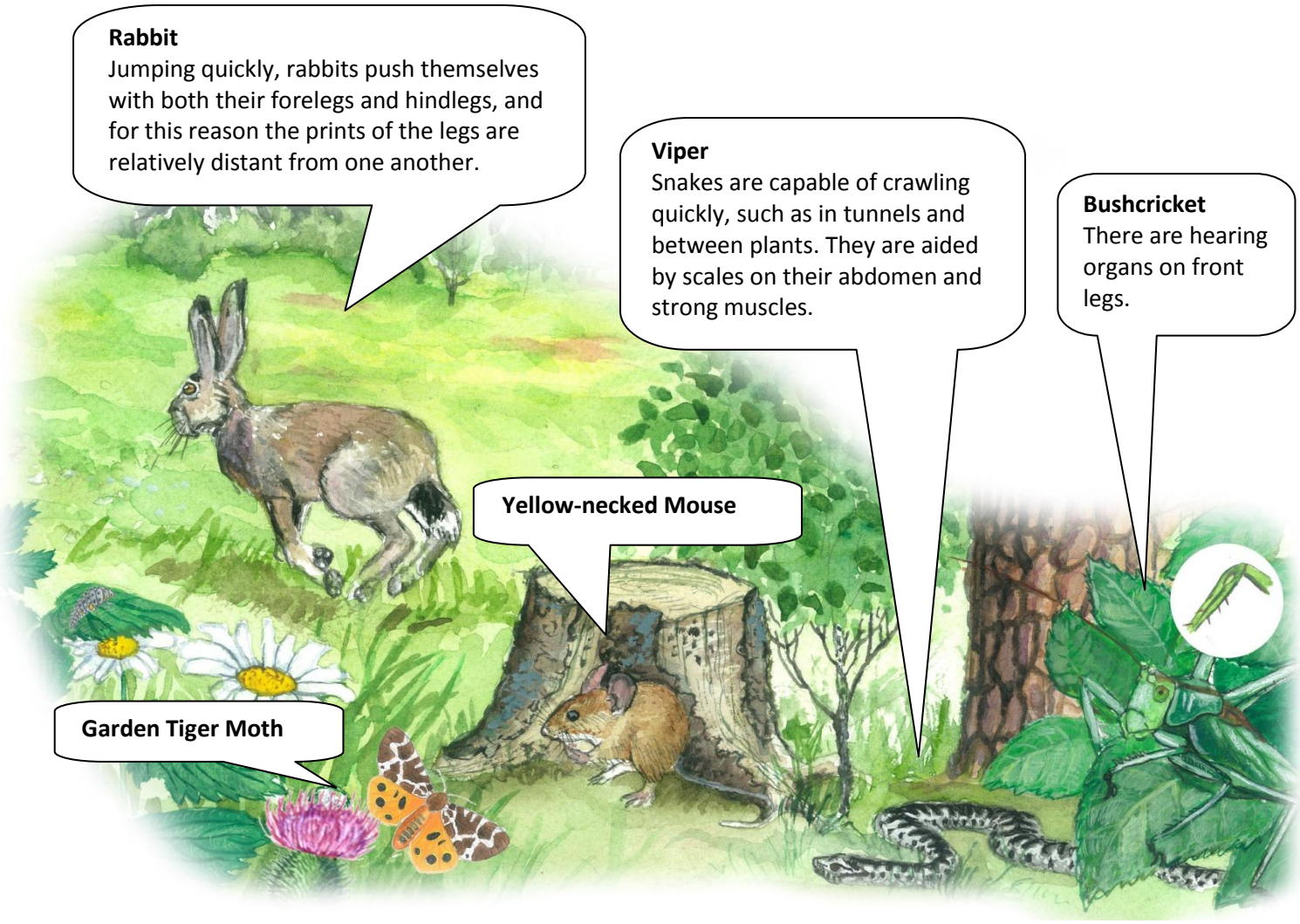
CLIMBING
Lynx
Climbing is assisted by claws and strong legs. When climbing, the lynx extends its claws, in other times they are usually retracted.

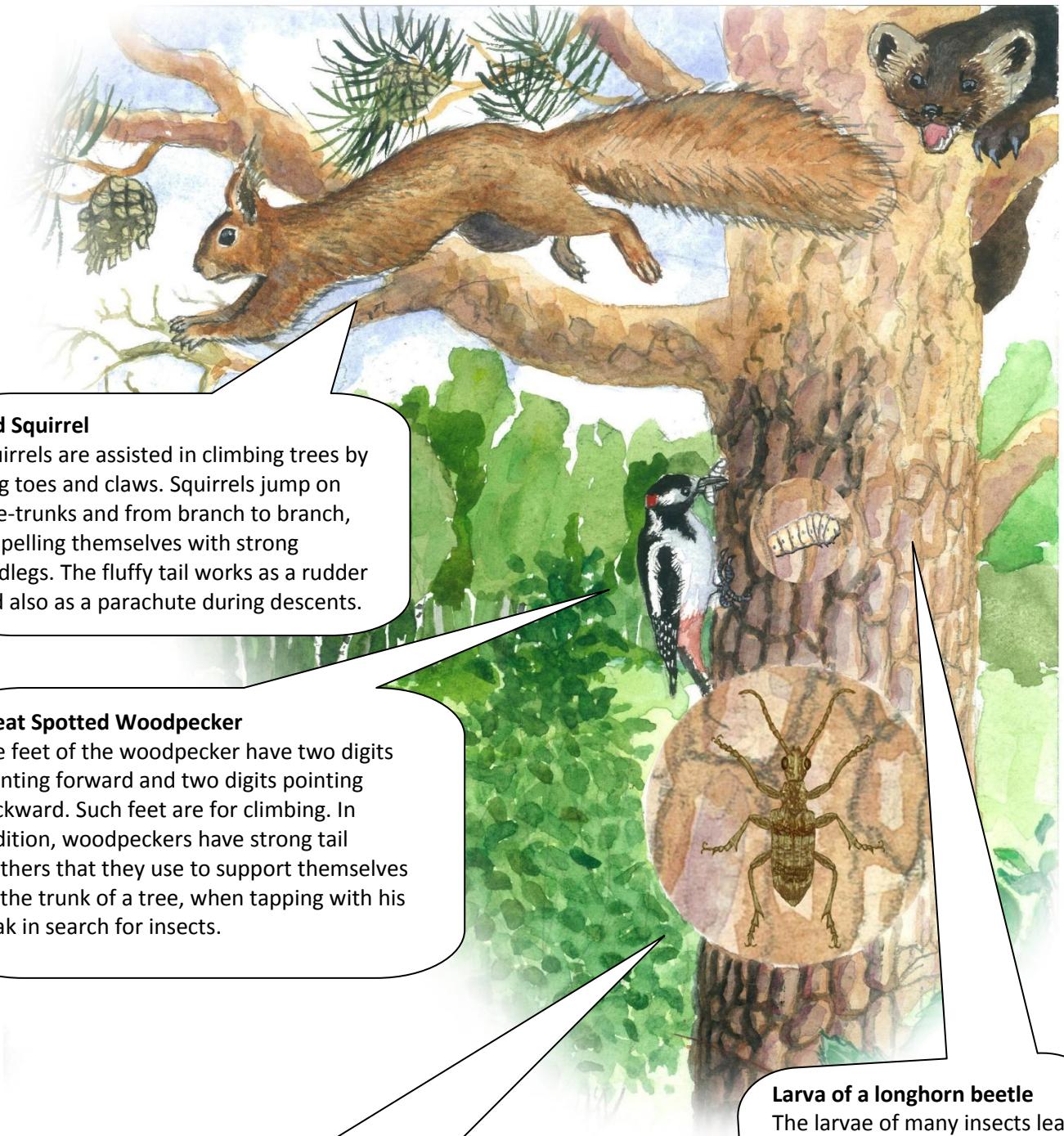
RUNNING
Fox
Many predators must run fast to cover long distances and catch fleeing prey.

WALKING
Hedgehog
By moving slowly, one can better observe the surroundings and search for food.

JUMPING
Bushcricket
Jumping allows one to move quickly, to escape and hide from the enemy. The hind legs of bushcrickets are long and used for jumping.


Seven-spot Ladybird
Caterpillars are the larvae of butterflies. They feed on plants. Besides the six thoracic legs, caterpillars have five prolegs with which to hold onto leaves and twigs.
Sawfly larva are different from butterfly larvae. They have more than five prolegs.
Caterpillar of a Peacock Butterfly


Rabbit
Jumping quickly, rabbits push themselves with both their forelegs and hindlegs, and for this reason the prints of the legs are relatively distant from one another.
Viper
Snakes are capable of crawling quickly, such as in tunnels and between plants. They are aided by scales on their abdomen and strong muscles.
Bushcricket
There are hearing organs on front legs.
Yellow-necked Mouse
Garden Tiger Moth



Red Squirrel
Squirrels are assisted in climbing trees by long toes and claws. Squirrels jump on tree-trunks and from branch to branch, propelling themselves with strong hindlegs. The fluffy tail works as a rudder and also as a parachute during descents.

Great Spotted Woodpecker
The feet of the woodpecker have two digits pointing forward and two digits pointing backward. Such feet are for climbing. In addition, woodpeckers have strong tail feathers that they use to support themselves on the trunk of a tree, when tapping with his beak in search for insects.

Larva of a longhorn beetle
The larvae of many insects lead a concealed life. The larvae of longhorn beetles live under the bark and in timber. Their movement is connected to eating: they chew themselves through timber.

Adult of a longhorn beetle
After pupating, the larva of a longhorn beetle becomes an adult. Moving around on its six legs, the insect supports itself on pads. Climbing is also assisted by claws and spikes on the legs.

Rhinoceros Beetle adult
Adult beetles have stocky strong bodies and digging legs that are equipped with spines. Male Rhinoceros Beetles have a large hornlike growth on their head.

Springtails
Small springtails live in decay. They are equipped with distinctive furculum, which, when they thrust it, allows them to jump.

Ground beetle
Ground beetles are the predators among insects. They have strong jaws and they are very mobile.

Rhinoceros Beetle larva
Larvae of the insects that live in soil often feed on decaying plant remains and underground parts of plants. The body of a beetle larva is whitish and fleshy. In addition to thorax legs, they use calluses on their body for movement.

Mole
The front legs of a mole are “shovels” with thick backward-directed claws that have adapted for digging. Moles press superfluous soil to the walls of their tunnels or on the ground. Earthworms are a mole’s favourite food.

Earthworm
Earthworms use their circular and longitudinal muscles for locomotion. A worm stretches out by contracting its circular muscles and contracts by straining its longitudinal muscles. Its movement is assisted by slime and small backward-directed setae situated on its lower body part and sides.

Remains of animals are food for many living organisms.
Burying beetles bury the remains of smaller animals in the ground. They can even move a carcass, for example, from a roadside to a place with softer soil. Eggs are laid in the buried remains. Burying beetles feed their offspring with half-digested food.
A blowfly’s body has a greenish or bluish metallic shine. Their larvae are maggots that live and feed in carcasses.

Blowfly

Burying beetle

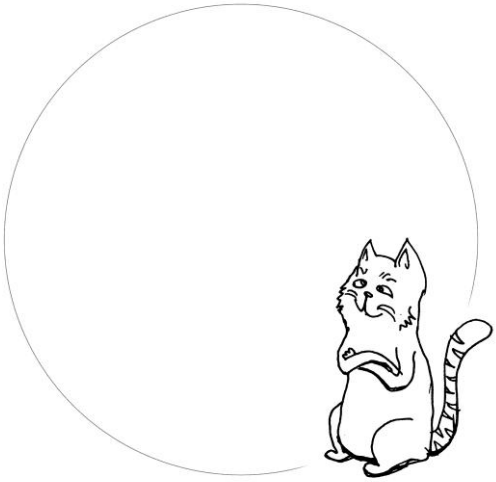
EXERCISES

1. Which features of anatomy match the given ways of movement? Join the correct pairs with a line. One feature may match with several ways of movement.

Long hind legs	Jumping
Strong front legs	Climbing
Long toes	Digging
Snake-like body	Crawling
Long legs	Running
Sharp claws	
Slimy body	

2. Cat paws

If you or a friend has a friendly cat, examine its paws and claws. How many toes do a cat's front and hind legs have? How does a cat hold its toes when it is resting and when it is walking? How many toes touch the ground when it is walking? Examine the pads of the cat's paws. Draw a picture of the underside of a cat's paw. Let the cat walk on wet or muddy ground, then let it make some steps on a white sheet of paper. Examine the cat's footprints and compare the footprints of the front and hind legs. Gently stroke the cat's toes and watch how the cat stretches its claws out and pulls them in again.



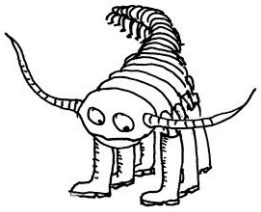
Look out! Although cats are cute pets, hidden inside them are predators that can scratch and bite quite painfully.

3. Watching animals' movements

Observe how birds move on the ground. Some birds jump, while some run or walk slowly. Watch different species of birds and note how they move. What are they doing while moving on the ground? Do they halt or take off from time to time? Try to draw a bird's moving trajectory on the ground. Are there any regularities in the movement?

Observe the movement of an insect on the ground or on a plant. How does it move its legs? How many legs does it lift at once? Is its movement steady or does an insect halt from time to time? What else characteristics can you notice?

4. Thousand or hundred legs?



In shady places, under stones, pieces of wood and tree bark are myriapods – centipedes and millipedes. Gently raise one of them onto a smoother surface for observation. The creatures defend themselves by remaining still. For example, millipedes may roll themselves up.
Observe the behaviour of the myriapod.

- *How long does it take before it starts moving again?*
- *Observe the movement of the millipede's legs, which move like waves. How many waves can you notice?*
- *Does a millipede have a thousand legs? If you cannot count them, find the answer from a reference book.*

5. Frog's movement on the ground

Observe a frog's movement on the ground.
A frog supports itself with its hind legs when it jumps. How does a frog use its front legs while jumping?
Does the frog only jump or does it also walk? Its legs move alternately, not simultaneously, when it walks.
Watch a moor frog, common frog or a toad. What differences can you notice in their ways of movement? Also observe a frog's movement in the water.

6. Go for a run with a dog

Running with a dog helps you make interesting observations about how animals move. This will also help you get to know your friend better.

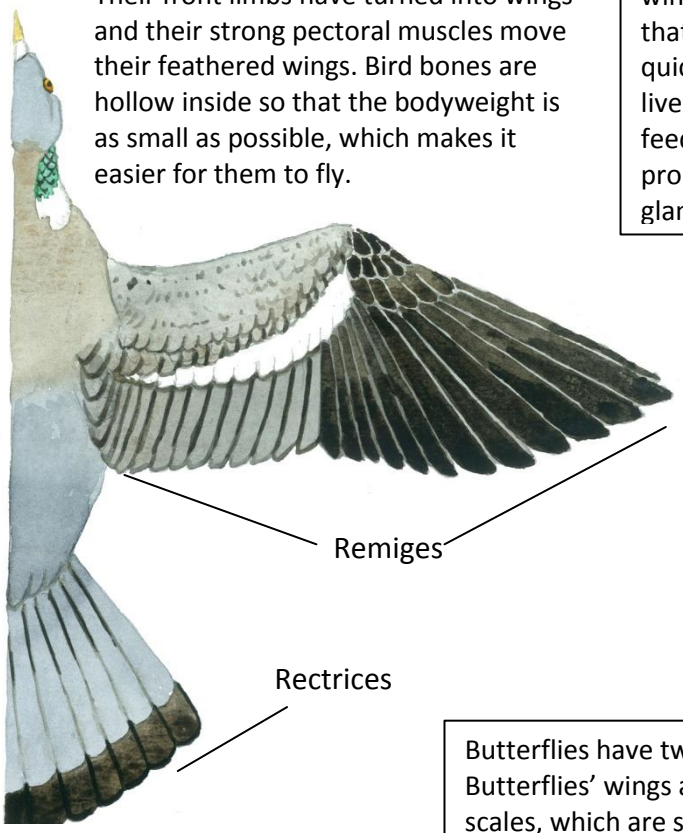
Begin by moving slowly and gradually pick up speed. If you are on a bicycle, you can measure speed with a speedometer. In winter, you can also examine footprints. **If you are running on a roadside, make sure you pay attention to the traffic!**

1. Observe how the dog walks. How do its legs move while walking? Does it walk calmly or does it try to move faster? Does it want to explore the surroundings?
2. The dog's movement changes by picking up speed. Observe how it moves its legs now. Does it sniff the surroundings or does it concentrate on moving?
3. Increase the speed. How does the dog move now? What else can you notice? When does running turn into jumping?

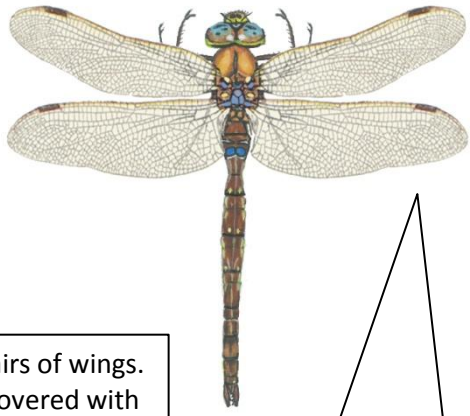
Note down how many different ways of movement you identified.
Which method of movement did the dog like most? Is this always the case when you go for a run?
Why did the dog prefer a particular movement?

MOVING IN AIR

Birds are adapted to moving in the air. Their front limbs have turned into wings and their strong pectoral muscles move their feathered wings. Bird bones are hollow inside so that the bodyweight is as small as possible, which makes it easier for them to fly.



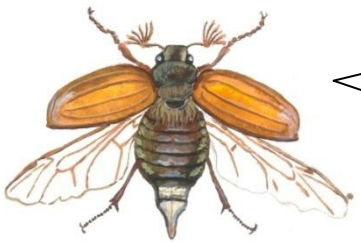
Like all flies and mosquitoes, the housefly has one pair of wings. Its hind wings are reduced and have become halteres that help to keep flight balanced. The housefly flies very quickly and can move its wings up to 33 times per second. It lives near humans, sewer pipes or on dumping grounds and feeds on excrement and rotten food by means of its proboscis. The housefly is able to hang upside-down thanks to gland pads under its legs.



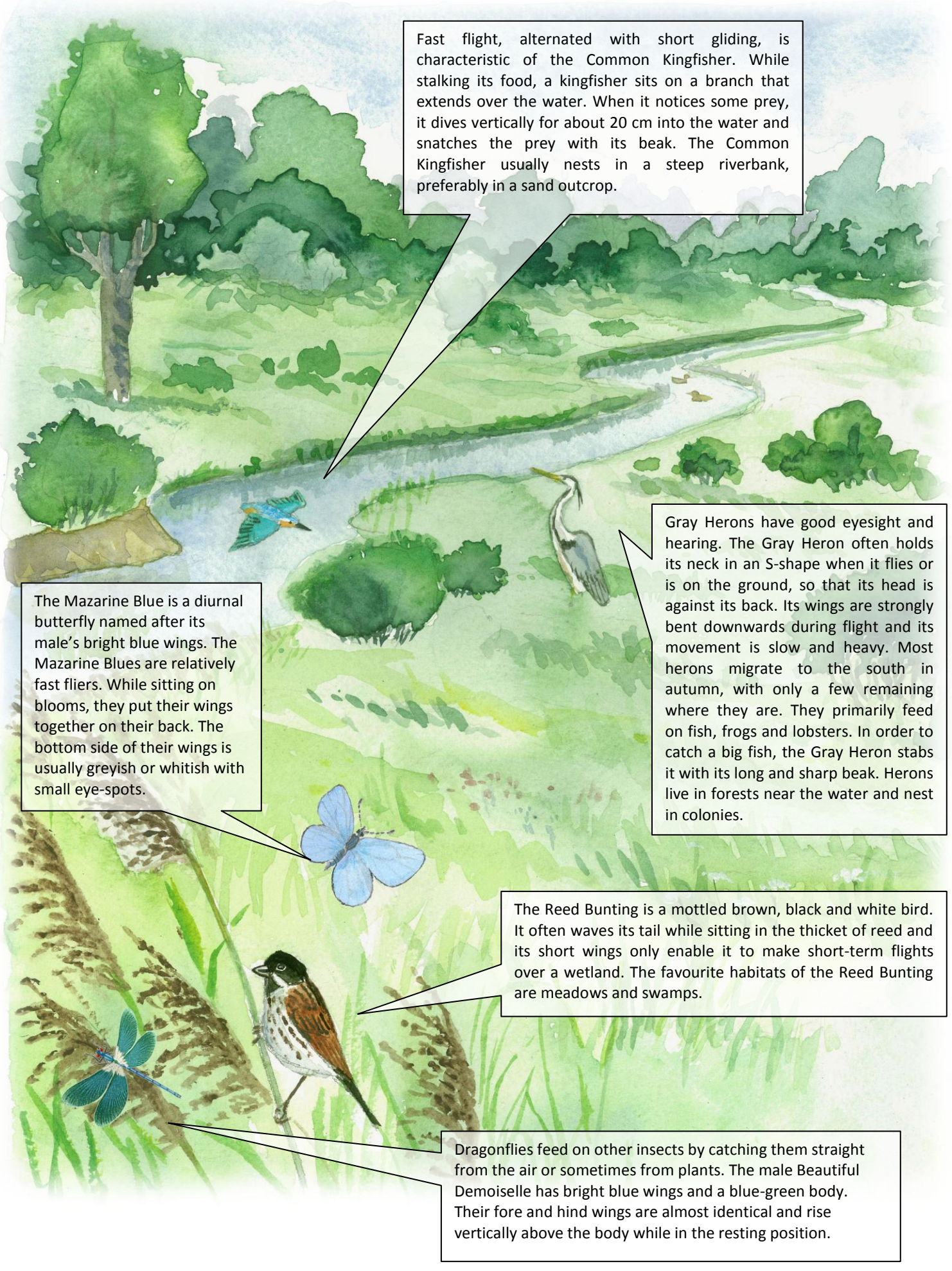
Butterflies have two pairs of wings. Butterflies' wings are covered with scales, which are situated so that half of one scale covers half of the next one. The European Peacock is a species of butterflies that belongs to the family of Nymphalidae. Its wingspan is 40–50 mm. The European Peacock is easily recognisable due to large eye-spots and bright colours.

Hawkers, the largest insects in Estonia, belong to the order of Odonata (dragonflies). They manoeuvre skilfully and are fast flyers. They have two pairs of wings but the pairs are not attached to each other and can move in different directions. The wings of the Brown Hawker are transparent, yellowish-brown and have black veins. Large eyes give hawkers wide range of vision; it is able to see clearly up to 10 metres.

Female Winter Moths' wings are diminished and they are not able to fly. They attract males by exuding a smell.



Beetles' forewings have become hardened. They are called elytra. Under the elytra are transparent hind-wings that are used for flying. In order to fly, a beetle lifts its elytra and extends its hind wings. The Cockchafer is a nocturnal animal and orientates itself by means of antennae, which resemble small fans. Antennae are olfactory organs that allow a beetle to smell food from far away. Mass flight of Cockchafers means that it is their "wedding time".



Fast flight, alternated with short gliding, is characteristic of the Common Kingfisher. While stalking its food, a kingfisher sits on a branch that extends over the water. When it notices some prey, it dives vertically for about 20 cm into the water and snatches the prey with its beak. The Common Kingfisher usually nests in a steep riverbank, preferably in a sand outcrop.

Gray Herons have good eyesight and hearing. The Gray Heron often holds its neck in an S-shape when it flies or is on the ground, so that its head is against its back. Its wings are strongly bent downwards during flight and its movement is slow and heavy. Most herons migrate to the south in autumn, with only a few remaining where they are. They primarily feed on fish, frogs and lobsters. In order to catch a big fish, the Gray Heron stabs it with its long and sharp beak. Herons live in forests near the water and nest in colonies.

The Mazarine Blue is a diurnal butterfly named after its male's bright blue wings. The Mazarine Blues are relatively fast fliers. While sitting on blooms, they put their wings together on their back. The bottom side of their wings is usually greyish or whitish with small eye-spots.

The Reed Bunting is a mottled brown, black and white bird. It often waves its tail while sitting in the thicket of reed and its short wings only enable it to make short-term flights over a wetland. The favourite habitats of the Reed Bunting are meadows and swamps.

Dragonflies feed on other insects by catching them straight from the air or sometimes from plants. The male Beautiful Demoiselle has bright blue wings and a blue-green body. Their fore and hind wings are almost identical and rise vertically above the body while in the resting position.

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The Eurasian Woodcock hunts its prey by silently moving on the shores and catching invertebrates with its long beak. The eyes of the Eurasian Woodcock are relatively high up, which provides it with wide range of vision. The Eurasian Woodcock takes off with a characteristic whirr and flies quite slowly compared to other waders. During a courtship display flight, a male flies alongside clearings at the height of treetops and makes squeaking or croaking sounds. The Eurasian Woodcock prefers sparse forests with a body of water for its habitat.

The Sedge Warbler is an insectivore that moves in low shrubberies or herbaceous areas. Sedge Warblers usually builds their nests near the water and usually hide them so well that it is difficult to find them, even when adults feed their young. Song-flights are characteristic to the Sedge Warbler. While singing, a bird rises to a height of around two to five metres, makes a circling flight and descends slowly back on a twig holding its wings in a V-shape.

Long and narrow wings enable the Common Cuckoo to fly quickly. Its flight is linear. A cuckoo does not build its own nest but lays an egg straight into a small bird's nest while its owner is foraging for food. A cuckoo feeds on insects. Cuckoos can be found in forests, shore thickets, parks, gardens – depending on where the owner of the nest is.

The White-tailed eagle is the largest raptor in Estonia. Its wingspan can reach up to 2.5 metres and it can weigh up to 6 kg. Its wide, long wings enable the White-tailed Eagle to glide in the air without moving its wings very much. The eagle even stalks its prey by gliding, after which it rapidly descends on the prey and grasps it between its claws. One can also see a hunting White-tailed Eagle flying a couple of metres above the sea. The White-tailed Eagle is easily recognisable by its light tail, which is spread like a fan during the flight. While an eagle flies, it holds its neck and tail below the centre line of its body. The White-tailed Eagle is a protected species and it usually builds its nest on the coast or in mixed forest. When winters are warm, adult birds remain near the nest area for the whole year. White-tailed Eagles primarily feed on waterfowls and fish.

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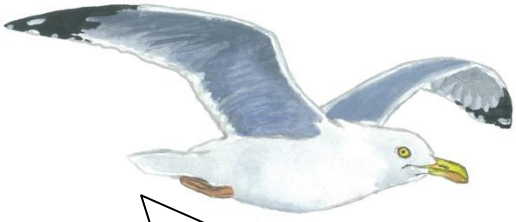
The Common Buzzard soaring
While soaring, birds take advantage of rising air in order to move forwards or rise higher without flapping wings. Soaring demands a large pair of wings.



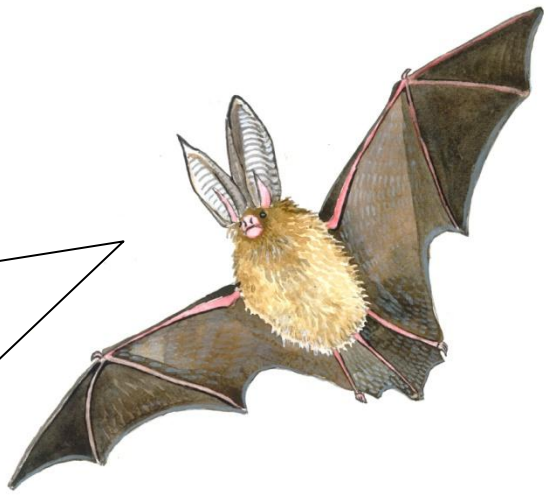
The European Herring Gull on flapping flight
During flapping flight, birds' wings constantly move up and down. This is the most common flying style among birds.

The Pied Flycatcher on hovering flight
Hovering flight is a type of flapping flight. During hovering flight, a bird constantly moves its wings but tries to remain in place at the same time. The Pied Flycatcher applies hovering flight to catch insects from the air.

The Northern Lapwing making courtship display flight
One can see the courtship display of the Northern Lapwing at the time of their arriving to the nesting areas and even migration. It is accompanied by a series of "kii-vit" sounds and a distinctive swish, created by round wings. Unlike other ***Charadriiformes***, the Northern Lapwing does not have a long sharp beak. It can be seen in fields but it prefers wetter areas. In order to divert an enemy, a lapwing flies away from its nest by flapping its wings and making a plaintive noise.

Spider waiting for the wind
Young small spiders are able to "fly" in the air by means of their thread. It is called "ballooning". They secrete thread from silk glands and the wind raises a spider and its thread into the air. This way, young spiders spread further from their birthplaces.

The Brown Long-eared Bat
A bat's wing structure is different from that of a bird's. Bats' forelimbs have a soft skin membrane, called a patagium, between their extended digits, which extends to the hind legs and tail. While flying, the Brown Long-eared Bat stretches its fingers out to its sides and the patagium tightens. The wingspan of the Brown Long-eared Bat patagium is 24–28 cm. Its hunting is characterised by hovering flight. It mainly feeds on butterflies and insects, both when they are flying and from branches and leaves. Bats apply echolocation to move. They create an ultrasound in their throat and make it audible through their nose or mouth. The sound reflects back from tree trunks, leaves, buildings, cliffs and other objects and the bat's ears catch it. This way, a long-eared bat gets to know the size and distance of an object. It mostly applies echolocation to locate its prey.



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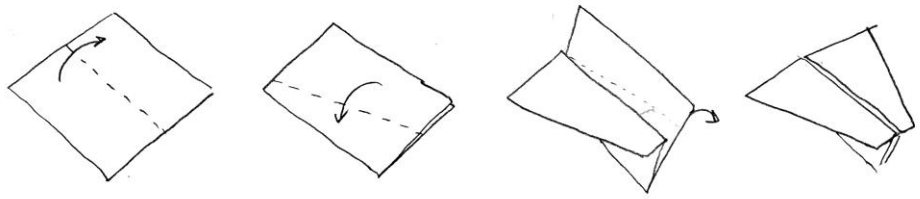
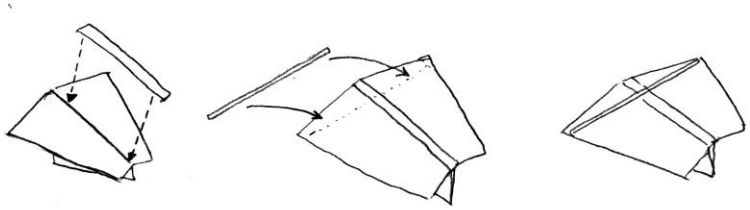
EXERCISES

1. Make a kite as shown on the scheme.
   Observe the flying kite that resembles a soaring bird. Why does the kite remain in the air? How would you describe the kite's movement? What bird does this movement resemble?



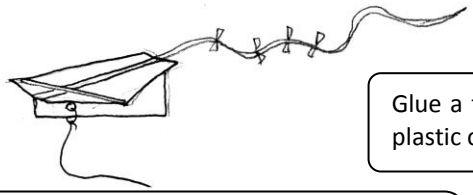
Fold the paper in half

From both sides, fold the paper back along the slanting lines



Tape the wings together from the top

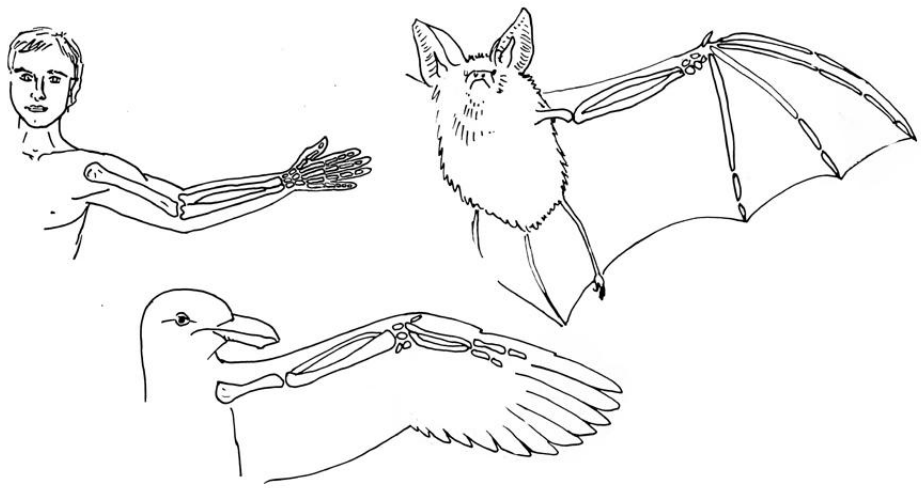
To strengthen the wings, stick a straw or splinter across them



Glue a tail to the kite. This can be a strip of thin plastic or paper.

Make a hole in the kite (about one-third of the way from the bottom edge) and fasten a string that, when you hold it, will allow you to fly the kite. Before making a hole, glue a piece of stronger paper there.

2. Colour the extremities of the human being, the bird and the bat on the scheme so that the same type of bones have the same colour. (Take a look at the scheme in the introduction.)

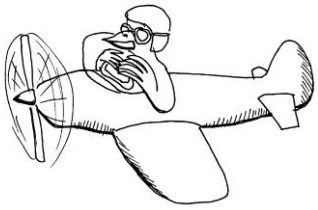


3. Join the insects with correct wing structures

Two pairs of transparent wings	Butterflies
Hardened forewings	Female Winter Moth
Two pairs of wings covered with small scales	Dragonflies
One pair of transparent wings	Flies
Wings are reduced	Beetles

4. Compare the flight of a bird with long and wide wings (for example, the White-tailed Eagle) and the bird with short narrow wings (such as the Common Kingfisher). Describe it (slow/fast flyer, moves wings frequently/rarely, wings are bent/straight, stays in the air for long/short period). What are the advantages of one birth over another?

5. Observe bird flight in your backyard. Describe how different birds take off, how they move in the air, how fast they move their wings, describe their movement in the air (move straightforward, fly in spiral), what flying type they use (soaring, hovering, gliding, etc). Draw the bird that you watched. How does it look – legs, wings, beak (their size and shape)? What is the bird doing (feeding, escaping from an enemy, etc)?



6. Beetles, like dragonflies, have two pairs of wings. Compare the body structure of the Seven-spot Ladybird with that of the Beautiful Demoiselle, as well as their movement during the take-off, flight and landing.
   How are the wings placed in their resting position (folded together/raised above the body)?
   Which of the species is faster is the faster flyer?
   What are the elytra's advantages over membranous wings and the other way round? Why do you think beetles have foldable hind-wings?

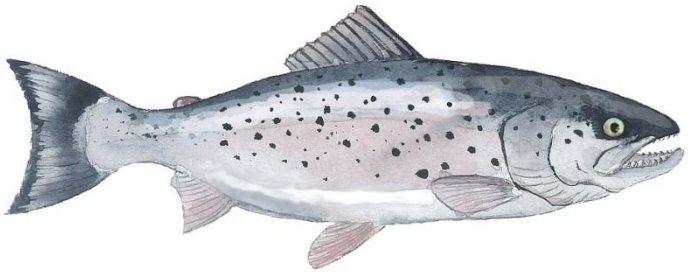
ANIMAL MIGRATION

The Black Stork is the lesser known related species of the White Stork. Unlike the White Stork, the Black Stork does not like being close to humans and builds its nest in indigenous forests. It feeds on fishes and amphibians, which it mostly hunts from forest rivulets and ditches, rarely on the shores of a larger body of water and meadows. Between 100 and 115 pairs of Black Storks are currently nesting in Estonia.

The wintering areas of the Black Stork may be anywhere from the Mediterranean Sea to the equator. From Estonia they set off alone or as couples in the second half of summer. If a bird finds a favourable feeding spot, it may stop migrating for weeks or even months.
A radio transmitter was placed on the back of Raivo, a male Black Stork, in 2008 and he has made several journeys south with it.

Various technical devices help to examine the movement of birds. It is possible to locate a bird by attaching the device on its back. Nowadays, the satellite system is used for precise location. In addition to exploring migration routes, it gives us information about the bird's feeding places. This all helps to arrange better protection for the birds.

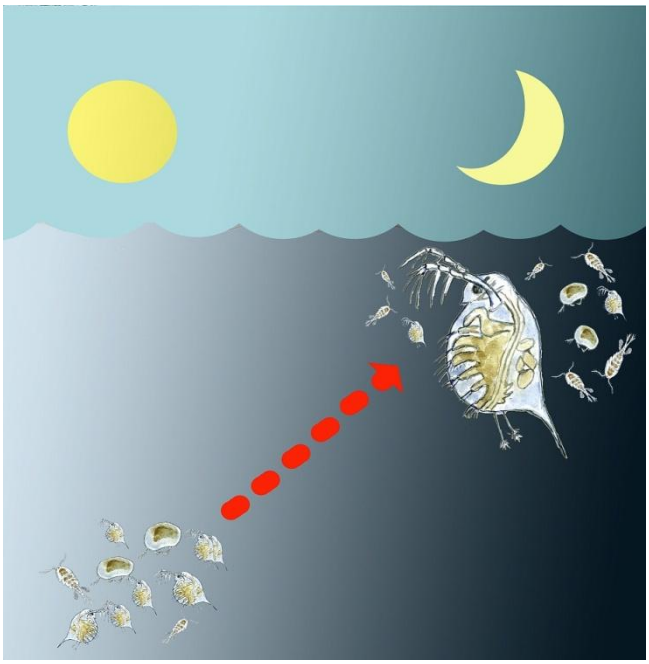
Geese often stop for nourishment on coastal meadows and fields. The Barnacle Goose can be seen feeding in the coastal areas.



Antlantic Salmon lives the first years of its life in a river, after that in a sea.
Fish reach sexual maturity in the sea and then they come into the rivers to spawn.
Salmons almost always return to the rivers where they were born to spawn. The rivers in which salmons spawn contain plenty of rapids and have gravelly riverbeds. Young salmon develop in these rivers, so pure and oxygen-rich water is important. Young salmon feed on water invertebrates, while in the sea, they feed on other fish. After spawning, salmon die and may become food for scavenger mammals and birds.

Only about 10 rivers in Estonia are still suitable for spawning and developing young salmon. The total length of all the suitable parts of rivers is only about 20 km. All of these rivers flow into the Gulf of Finland. Dams and hydroelectric power stations have become the main obstacles to salmon spawning places. Before the Narva hydroelectric power station was completed, the Narva River used to be the most important spawning place for salmon in Estonia. Salmon do not spawn there any more.

Predators that mainly depend on sight to find their prey feed on zooplankton during the daytime. Therefore, many zooplankton have developed round-the-clock migration. During the day, they move into deeper layers of water where it is darker and there is less risk of them becoming prey. At night, they come to the surface layer to feed.



Glossary:

Zooplankton – tiny drifting organisms (animals) in a body of water.
Spawning place – a place where fish spawn. The prevailing conditions (oxygen content, temperature, flora, etc.) determine the area's suitability for spawning.
Spawning – the way that fish and amphibians reproduce by laying gametes into the water.
Hydroelectric power station – a power station where electricity is produced by means of flowing water.

The Common Toad is an amphibian that lives mostly on land. When it winters, it digs itself into the ground. During the spring spawning season, toads migrate back to the bodies of water where they were born and where they grew up as tadpoles. Similar behaviour can be observed among many other frogs that live on land. It is especially striking when there happens to be a road on the migration route, when hundreds of frogs can perish under car wheels. Newts may also perish on their migration to the bodies of water where they reproduce.
Green frogs, which spend most of their life in or near the water, do not migrate in such numbers.

When more than 60 cars drive on a road in an hour, up to 95 percent of the frogs crossing the road are squashed by the cars' wheels. During springtime, vast amount of frogs that go to spawn die in this way. Bigger animals – such as hedgehogs, martens, foxes, roes, elk and even bears – also perish while crossing roads. Animals cross roads for different reasons. Larger animas often do it in order to find food, a mating place or new territory.

There are several ways to ensure safe road-crossing for animals. Tunnels with collecting areas in front of their mouths are being constructed under the roads for smaller animals. Frogs and small mammals can use such tunnels. The sides of under-bridge ditches are equipped with shore paths for bigger animals. The most expensive are the animal bridges that are built over roads and as naturally as possible. These bridges cross smoothly to the natural environment, which means that animals are not afraid of stepping onto them.

Human and animal migration

Human activity can either obstruct or encourage animal migration and distribution. Since animal migrations usually follow the set routes, constructions such as roads, dams, ditches and settlements may disturb their migration.
Humans encourage animal distribution by transporting the species that are necessary for them to new habitats. Animals can also get on ships, planes, trains and cars.

Introduced species can enter bodies of water via ships, mostly through ballast water and ship halls. In order to improve or alter a ship's buoyancy, ballast water is pumped into its lower parts. When the ballast water is pumped out, the organisms that were in it will also enter the sea water. Every year, more than a hundred million tons of ships' ballast water, containing specimens of hundreds of species, is brought into the Baltic Sea.

Many marine animals have extended their habitat with the help of ships. For example, Soft-shelled Clams presumably moved from the Atlantic Ocean into the Baltic Sea on Viking ships in the 12th and 13th centuries. Soft-shelled Clams have now become one of the commonest species of clam in the Baltic Sea.

The American Mink was brought to Europe for its fur. The animals who escaped breeding farms coped very well with the local nature and drove **European Mink** out. The European Mink has become in danger of extinction. Protecting it often involves exterminating American Mink.

European mink

American mink

EXERCISES

1. **Counting birds in a flock**

Nobody is able to count birds one by one in a flock of hundreds or thousands. Even so, ornithologists can quite accurately estimate migrating flocks by means of counting. To do this, they visually select a small part of a flock, count the birds in it and estimate the approximate number of such groups that can fit into the flock. Basically, it is multiplication. Start by trying this method of counting on a picture and then go outside and try it on real birds.

2. **Think about salmon migration. Write down the obstacles and dangers that the fish may encounter on their way to spawning areas. Previous introduction of salmon can be helpful.**

Human-related dangers	Natural dangers

3. **Roadside death**

See how many perished animals there are by the side of a road. Pick a certain distance of roadside (500 steps, from one milestone to another, etc) and note down all of the dead animals you can see. If possible, also try to identify the species of these animals (e.g., Whooper Swan, European Roe Deer, Raccoon Dog, Hooded Ccrow, etc) or the animal class (frog, bird, mammal, reptile, etc.).
Note. Make sure that car drivers can notice you! Wear a reflector vest. Carry out the counting only on one side of the road. Crossing the road may be dangerous! It is advisable to perform this task together with an adult instructor.

4. Research with a book

In the book "European Birds", the territories where bird species live permanently are marked in dark green on the maps next to the species.
For following species, record whether they remain in Estonia for the winter or migrate south. Try to find out what the wintering species feed on during winter.

Chaffinch --- Great Tit --- Common Crane --- Western Capercaillie --- Thrush Nightingale --- Common Redstart --- Ural Owl --- Common Blackbird

Write for each species, if it migrates / remains in Estonia and what it feeds on in winter if stays.

5. Migration diary

You can prepare for this assignment throughout the winter. Get to know the appearance of some easily recognisable migrating birds, such as the Northern Lapwing, the Grey Heron, the Mute Swan, the Common Starling or the Chaffinch. Explore bird guides and find pictures from the Internet. The more different pictures you see of a bird, the better you will remember it. Find out what kind of habitat it lives in.

Acquire a small diary or do it yourself with a squared exercise book.

When spring arrives, start observing the places where the birds you are interested in usually live. Write down all the occasions when you see the bird. This way you will collect interesting observation data that you can compare with the notes of other bird enthusiasts in bird forums or in a school paper or research. It is even more interesting when you have data for several years.

An example of a diary:

	Northern Lapwing	***Common Starling***	***Black-headed Gull***
2nd of April	On the field of Kiviküla, 2 birds	Sang on the neighbour's aerial	In the city, near rubbish bins
11th of April	On the field of Repsiku, 1 birds	In the village of Nauksi, on an oak, 3 birds	A big flock on the field of Repsiku

6. Migrants' competition

2-4 players. Find a large map of the world that has clearly marked rivers, mountain ranges, deserts and other terrain, and put it flat on the table or floor. Every player should have a small coloured button and a game piece. Agree on what kind of animal you each are – you can be a bird, fish, mammal, reptile, etc. Close your eyes and toss your button onto the map. The spot where it falls is the destination of your migration. Begin your journey from Estonia (or, if you and your friends are in Lithuania, Italy or America instead, begin from there). Count all the obstacles that are on your way. Think about whether your chosen animal would be able to overcome the obstacle or have to go around it. The player who has to go around the smallest number of obstacles has the most efficient migration route.