



Fig. 1: Swallowtail (*Papilio machaon*)

Butterflies

Butterflies demonstrate vitality, beauty and the diversity of nature better than any textbook. By studying butterflies, students can follow a fascinating process of transformation: the complete metamorphosis from caterpillar to butterfly. To see attractive butterflies hatching from their chrysalises is a spectacular climax to the activity.

1. Factual information about butterflies

Biology

Butterflies belong to the group of insects which go through complete metamorphosis and pass through four stages of development: egg, larva (caterpillar), pupa, and butterfly. In the caterpillar stage they have three pairs of legs attached to the thorax like other insects but they also have four more pairs of false legs. The most striking feature that butterflies have is their brightly-coloured wings which make them beautiful. Millions of tiny scales (which you can only see with a magnifying glass) give the order *Lepidoptera* (meaning "scale wings") their name. When they visit flowers, you can see their long proboscis which is like a straw. When the butterfly is resting this is rolled up under the head. The proboscis can be very long; for example the Convolvulus Hawk-moth has a 15 cm long proboscis.

Butterflies have coloured wings to attract a partner, to camouflage themselves or to frighten away their natural enemies. The colours are created by pigments and light refraction in the scales. Depending on the way the light is falling on the scales, some butterflies can even look metallic. These colour effects are created in two ways: by colour

Fundamental aims of the activities

- To learn about and experience complete metamorphosis
- To accept responsibility for the development and care of an animal
- To recognise that there are connections between habitats and numbers of butterflies found



Fig. 2: Eggs, caterpillar, pupa and butterfly of the Swallowtail Butterfly (*Papilio machaon*)

pigments and by the special structure of the scales. The combination of two pigments colour the tiny scales on the wings. Melanin causes black, brown, rust brown and dark yellow colours. Pterins cause banding patterns. All the other colours are caused by the structure of the scales which affects the way the falling light refracts and reflects. Shining white scales, for example, contain air-filled cavities that reflect all light like snow does and therefore gleam white. Blue and green tones as well as the metallic shine are caused by light refraction.

The species used for the suggested activities have been chosen because of their fast rate of reproduction. These develop faster and are easier to find.

Species with fast rates of reproduction live in temporary habitats such as in pioneer communities which live where there are no other or nearly no other species yet, in fields of wild flowers and in waste areas. As strongly flying, roving or migratory species they are far less endangered, because they can choose their biotope. Typical members of this group are the Peacock Butterfly, the Small Tortoiseshell Butterfly, the Red Admiral Butterfly as well as the Large White (Cabbage Butterfly).

Species with slow rates of reproduction cannot go to another habitat when their current habitats are changed or destroyed. They are more endangered because of this. A typical member of this group is the (Mountain) Apollo (*Parnassius apollo*).

Butterfly Habitats

Most species are found on unfertilised and species-rich grassy areas, in sparse forest and at the edges of structure-rich forest with good sunlight. Some species can only exist in special types of meadows, unfertilised grassy areas or types of forest because that is the only place where they can find their particular feeding plants. Therefore you find different species of butterflies in wetland forests than in mixed oak forests or in sunny, dry pine forests. In pine forests, for example, you can find extremely large number of the Eastern Pine Processionary Moth in favourable years.

Ecological Relationships

In complex food webs, butterflies are **plant eaters** in their caterpillar stage, **pollinators** in the butterfly stage, and provide an important **source of food** for insectivores and specific parasites. Butterflies prefer flowers with long tubes because they have a very long proboscis. Many plants require butterflies to pollinate them because they have specially shaped flowers.



Caterpillars are an important, protein-rich source of food for songbirds and other insectivores. Butterflies and moths are prey for songbirds during the day and for bats at night. The populations of these species depend heavily on this food supply. Because they hunt at night, bats in particular depend on moths for their food.

Endangered

104 of the 172 species of butterflies in Bavaria are endangered. At 60 %, the proportion of species which are endangered is disproportionately high. This is a clear sign of dramatic changes in our landscapes. Intensive ways of using the land mean large areas no longer habitable and have very few flowers. In intensively used fields and meadows and in forests that do not contain different types of trees, there are no feeding plants for caterpillars and no flowers for butterflies either. As well as this, the fragmentation of habitats because of streets and “light pollution” because of artificial lighting in towns and along roads at night plays an important role.

Choosing a species for temporary keeping – outline

The best species are those that are common and widespread and that are not endangered or protected by law. Other criteria are the attractiveness of the caterpillar or the butterfly and how easy it is to keep them. The only exception is the Swallowtail Butterfly, which is protected by law. The sequence below corresponds to the suitability of the species for the activities.

Butterflies

It is quite easy to find the caterpillars of the following brush-footed (or four-footed) butterflies (belonging to the family *Nymphalidae*):

- Peacock Butterfly (*Inachis io*) on stinging nettles (*Urtica dioica*)
- Small Tortoiseshell Butterfly (*Aglais urticae*) on stinging nettles (*Urtica dioica*)
- Map Butterfly (*Araschnia levana*) on stinging nettles (*Urtica dioica*)



Fig. 3: Peacock Butterfly (*Inachis io*)



Fig. 4: Small Tortoiseshell Butterfly (*Aglais urticae*)



Fig. 5: Map Butterfly (*Araschnia levana*)



Fig. 6: Red Admiral (*Vanessa atalanta*)



Fig. 7: Swallowtail Butterfly (*Papilio machaon*)

With more effort you can find

- Red Admiral (*Vanessa atalanta*) on stinging nettles (*Urtica dioica*)

From the family of swallowtail butterflies (family *Papilionidae*) there is a real beauty but you need a lot of effort to find it and should only keep it on garden plants. It is the

- Swallowtail Butterfly (*Papilio machaon*) on fennel, common rue, carrots, caraway, dill and other plants of the order *Umbelliflorae*

The Common Large White (Cabbage Butterfly) and the Painted Lady are not suitable because they are often infested with parasites.

Moths

You need some effort to find the

- Elephant Hawk-moth (*Deilephila elpenor*) on willowherb, fuchsia and other plants
- Convolvulus Hawk-moth (*Agrius convolvuli*) on field bindweed and hedge bindweed

Not often found but a real beauty, the

- Death's Head Hawk-moth (*Acherontia atropos*) on potato plants (not sprayed) and other plants of the nightshade family as well as privet



Fig. 8: Elephant Hawk-moth (*Deilephila elpenor*)



Fig. 9: Convolvulus Hawk-moth (*Agrius convolvuli*)



Fig. 10: Death's Head Hawk-moth (*Acherontia atropos*)



Biology of the selected species

Butterflies

Peacock Butterfly (*Inachis io*)

This is a well-known, common butterfly with a wingspan of 5-5.5 cm. The striking eyes provide very effective protection against enemies. When they are resting with their wings closed they look like dried leaves. When danger threatens, they quickly open their wings and make a hissing noise.



Abb. 11: Tagpfauenauge (*Inachis io*)

Development:

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Butterfly	X	X	X	X		X	X		X	X	X	X
Egg				X	X		X	X				
Caterpillar				X	X	X		X	X			
Pupa					X			X				

X = A very good time to look for caterpillars

There are two generations of Peacock Butterfly each year. Egg laying can last for 4-8 weeks. Many eggs are laid (about 50-200) in a **pile** on the underside of stinging nettle leaves. The first generation establishes itself in spring. The young caterpillars live in groups and spin silk threads which mostly becomes like fine cobwebs (communal web).

Caterpillars' food: Stinging nettles (*Urtica dioica*)

Caterpillars: These can be found from the end of April on large areas of stinging nettles. They like a sunny and somewhat humid area such as the banks of streams and drainage ditches.

Observing the butterflies: The butterflies spend the winter in caves, sheds, and buildings, and on warm days they are already flying around in March. You can find them almost the whole year long except in May and from the end of July to August. They love visiting butterfly bushes (buddleja), flowers of the Asteraceae family (asters, daisies or sunflowers), and culinary herbs (for example, marjoram), and in autumn also windfall fruits.

Small Tortoiseshell Butterfly (*Aglais urticae*)

The Small Tortoiseshell Butterfly has a wingspan of 4-5 cm. It lives in various habitats and it is widespread and common. It is a migratory butterfly and makes short migrations within its habitat. In autumn it often flies to warmer valley areas and the next generation comes back in early summer.

Development:

In most years there are two generations and in good years three. Egg laying often lasts 4-8 weeks. The eggs are laid in piles of 80-200 on the undersides of leaves. Until the last moulting the caterpillars live and feed together in a com-



Fig. 12: Small Tortoiseshell Butterfly (*Aglais urticae*)



Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Butterfly	X	X	X	X		X	X	X	X	X	X	X
Egg			X	X		X	X					
Caterpillar				X	X			X				
Pupa					X			X				

X = A very good time to look for caterpillars

munal web. They spread out over the stinging nettles before the last moulting.

The development from egg to butterfly takes **1-2 months** and is **strongly dependent on light and temperature**. Before it becomes an adult, the Small Tortoiseshell Butterfly spends half its time as a caterpillar and a quarter each as an egg and a pupa. The young caterpillars live and feed in a communal web, but the older caterpillars mostly live alone or in small groups. After about a month the caterpillars change into a brown or light green hanging chrysalis that has spines and gold-metallic spots. After resting in the chrysalis for a short time (about three weeks) the beautiful big butterfly emerges. Like the Peacock Butterfly, the Small Tortoiseshell Butterfly spends the winter in protected places like cellars, attics, garages, or in natural hiding places. On warm winter days this resting period may be disturbed.

Caterpillars' food: Stinging nettles (*Urtica dioica*)

Caterpillars: You can already find these at the end of April in light grey communal webs in full sun. After the first or second moulting the communal webs become more noticeable and are found lower down on the stinging nettles.

Observing the butterflies: This butterfly feeds from a wide range of nectar plants. They like tall herbaceous vegetation which includes hemp agrimony (*Eupatorium cannabinum*), large *Asteraceae* like thistles (*Cirsium spec.*), groundsel (*Senecio spec.*) or members of the *Lamiaceae* (mint) family.

Ecological interactions: The caterpillars are not eaten by birds but the pupas are. Probably the colour of the caterpillars has a deterring effect. Many caterpillars, however, are infested with parasitic diptera larvae.



Fig. 13: Map Butterfly (*Araschnia levana*)

Map Butterfly (*Araschnia levana*)

This butterfly is common in lower areas and is only seldom found above 1000 metres. There are great differences in the sexes: the females have a wingspan of 3.8-4.3 cm and are therefore larger than the males, which have a wingspan of 3.2-3.8 cm. The spring generation lives in fields near forests and in clearings, but the summer generation lives in deciduous forest and looks different: the wings have less colour (seasonal dimorphism).

Development:

Two generations: You can find caterpillars from the end of May until June and from August until September. The first generation is somewhat



Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Butterfly				X	X	X	X	X				
Egg					X	X	X	X				
Caterpillar						X		X	X			
Pupa	X	X	X	X			X	X	X	X	X	X

X = A very good time to look for caterpillars

smaller because of losses due to predators. The eggs are laid on the undersides of leaves in very **characteristic colonnettes** (unique among butterflies) with up to 10 eggs each. In the second generation these are very well camouflaged because the stinging nettles are flowering at this time of year. Because of the great similarity, the losses due to predators are much lower in the second generation.

The eggs are first green, then change colour to yellow, then become dark. After about 10 days the tiny caterpillars hatch. High humidity is important at this stage. If the humidity falls below 50% many embryos in the eggs die. In ideal conditions with a warm, moist climate, up to 95% of the caterpillars hatch. The caterpillars live together but spread out as their need for food grows. The caterpillars moult four times. The third stage is the shortest and is only three days long. The last stage is the longest (about a third of the total time of 18 days). In the last stage the females feed for longer before pupation.

To pupate, the caterpillars fix a small pad of cobwebby material and anchor their pygopodium (last body segment and pair of legs). This pre-pupation stage lasts for about two days. As is usual with hanging chrysalises, the skin splits down the back and the pupa becomes visible after much twisting and turning. The caterpillar's skin falls off or stays visible as a little bundle. This process is very dangerous for the caterpillar and there are often losses if it falls down. But if it survives the fall it can be attached again.

The pupae are green at the start. Later they become darker but several shiny metallic spots remain. The summer generation hatches after 14-18 days. The male butterflies hatch 2-3 days before the females. The autumn pupae hibernate.

Caterpillars' food: Stinging nettles (*Urtica dioica*)

Caterpillars: You can find them in shady places with high humidity like moist tall herbaceous vegetation, wetlands, sparse forest and also in transition moors. Caterpillars of the first stages live in groups together. The later stages spread out more and more.

Observing the butterflies: They like to feed on plants of the **white umbellifer family** (cow parsley, acanthus etc.), and also on thistles, hemp agrimony and other plants.



Fig. 14: Red Admiral Butterfly (*Vanessa atalanta*)

Red Admiral Butterfly (*Vanessa atalanta*)

The Red Admiral is a migratory butterfly and has a wingspan of between 5 and 5.6 centimetres. You can find it in various habitats like forests, open country with lots of flowers, and also in gardens and in areas of settlement. Central European butterflies fly north to southern Scandinavia and fly back to the areas where they spend the winter.

Development:

The eggs are laid **singly**. The caterpillars make themselves a hiding place from a leaf held together with cobweb thread. They only leave this

when they have eaten so much of it that it does not provide good protection any more. The caterpillars also pupate in their hiding place in a brown or grey hanging chrysalis.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Butterfly	X	X	X	X				X	X	X	X	X
Egg					X		X	X				
Caterpillar					X	X		X				
Pupa					X	X		X				

X = A very good time to look for caterpillars

Caterpillars' food: Stinging nettles (*Urtica dioica*)

Caterpillars: The caterpillars mainly live singly in partly shady groups of stinging nettles in a moderately damp microclimate (streams, ditches, forest clearings). You can notice them because of the hiding places they make from leaves spun with cobwebby thread. The stem of the leaf has often been chewed and the leaf house is hanging downwards.

When do they fly? The first butterflies arrive in early summer. Their offspring can be seen in the middle of summer. You can see the most butterflies from the end of August until the beginning of September. In Bavaria there is only one generation, from June until October. Butterflies that stay for the winter can be found at any time of year, but usually they die with the first frost. But the butterflies can manage to survive the winter if the weather is very mild.

Observing the butterflies when they are flying: You can see the Red Admiral Butterfly on plants which are easy to land on, such as the butterfly bush, large species in the daisy or aster families (for example, horse-heal, groundsel, sunflowers, asters, hemp agrimony) and many culinary herbs like marjoram or lavender. The best observations can be made on these plants on warm days. These butterflies especially love **sucking on rotting windfall fruit**. Therefore you can find them in orchards and parks on windfall fruit.

Swallowtail Butterfly (*Papilio machaon*)

The Swallowtail Butterfly is one of the largest and most striking and has beautifully coloured caterpillars. The male Swallowtail has a wingspan of over 6 cm and the female of over 7 cm. It lives in sunny and open areas, for example in areas of poor grassland and dry grassland, and also in gardens when fennel, common rue, carrots and dill are planted.



Development:

There are usually two generations, as an exception three. You can see the first generation in Central Europe from the end of April until June, depending on the climate. You can see the second generation from about the end of July to September. The first generation lays its eggs singly on young shoots from the end on May until June. The yellow-green egg become brown after a short time and then inky blue before it hatches. The young caterpillar hatches after a week and is only 2 mm long. Its first meal is the empty egg case. The young forms of the caterpillar (up to about 2.5 cm) look like bird droppings. They are black, but after the third moulting quickly develop into strikingly coloured caterpillars. After only two weeks they pupate using a "belt pupa" (the pupa is fastened to a twig or similar with silken threads around the middle). The second generation hatches from the middle of July and these butterflies also lay eggs which change into pupae. These pupae survive the winter, but the butterflies normally do not. The **caterpillar stage** lasts 4-5 weeks and **the pupa stage** 2-4 weeks.



Fig. 15: Swallowtail Butterfly (*Papilio machaon*)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Butterfly				X	X X	X X	X	X X	X X	X		
Egg					X	X X	X	X X	X X			
Caterpillar						X X	X X	X	X X	X		
Pupa	X X	X X	X X	X X	X		X X	X X	X X	X X	X X	X X

X X = 1st and 2nd half of the month X = A very good time to look for caterpillars

Caterpillars' food: Fennel, garden and wild carrots, parsnip, caraway and other members of the umbellifer family, and also common rue and dittany.

Observing the caterpillars: You can find the caterpillars from the beginning of June on the leaves of the plants mentioned above. When you touch them, the caterpillars make jerking movements with the front part of their bodies. To deter attackers, an orange-coloured organ behind the head (called an osmeterium) is turned upwards and gives off an unpleasant smell. This deters ants, for example. If turning it upwards several times has no effect, the caterpillar flees.

Observing the butterflies: You can see the Swallowtail Butterfly from May to June and from July to October on a wide range of plants with nectar, such as members of the aster and daisy family (for example thistles), members of the papilionaceae family like red clover and many others. They are well-known for their "hill-topping" behaviour: they fly to the highest point in their area such as hilltops, mountain summits or castle ruins and glide downhill looking for a mate.

For general information on keeping see Additional Materials A 1_1.

In addition for this species: Always keep feeding with the same plants that the caterpillar was found on; otherwise the caterpillar can develop abnormally.



Moths

Most of the members of the hawk-moth family are large moths with a fat body. It is easy to observe the Hummingbird Hawk-moth which almost stands still in front of flowers like a hummingbird. This species is one of the few moths that is active during the day. You can most easily find them on garden flowers with long calyxes like honeysuckle (*Lonicera*), phlox (*Phlox*) or evening primrose (*Oenothera*). The caterpillar is more common than the moth. The large caterpillars usually have a kind of spine at the end of their bodies. This is not dangerous at all.

The eggs are tiny in comparison (barely 1 mm) and difficult to find. The caterpillars leave particular traces when feeding. They do not eat the veins of leaves, there are large balls of excrement and also the leaves are nibbled at the edges. In general, very strong, mature plants are avoided and poor or puny plants are preferred.

Hawk-moths fly very fast and migrate long distances. Depending on the species they can reach speed of between 30 and 100 km/h. Their wings can beat with a frequency of 25-100 beats per minute. You can recognise this by their aerodynamic body shape and the extremely well-developed flight muscles (powerful chest muscles). Before taking off, the hawk-moths must warm up their flying muscles by vibrating them.

Elephant Hawk-moth (*Deilephila elpenor*)

This is a large moth with a wingspan of 45-60 mm. They are mostly seen flying in June and you can find fully-grown caterpillars at the height of summer. Because the caterpillar also eats garden plants you can find it in towns and cities, too.



Fig. 16: Elephant Hawk-moth (*Deilephila elpenor*)

Development:

The only generation flies out between May and June and after mating lays eggs, usually on willowherb, but sometimes also on bedstraw (*Galium*). The eggs are laid **singly** on the undersides of leaves. The 4-5 mm caterpillars hatch from the tiny (1.5 mm) eggs. The young hide during the day but the fully-grown caterpillars also feed during the day if the weather is cloudy. The brown or occasionally green caterpillars are found from **June to September**. They have striking „snake eyes“ on their heads. The caterpillars pupate in a cocoon on the ground, protected by old leaves and moss. The pupae spend the winter in this hiding place until they hatch in **May**. They hatch gradually, so that they can be seen flying over a long period of time.

Caterpillars' food: They prefer willowherb (especially *Epilobium hirsutum*, *E. parviflorum*, *E. angustifolium*), also bedstraw (*Galium*) and members of the *Impatiens* family. The caterpillar can be seen very easily when it has completely eaten plants such as fuchsia (*Fuchsia*), including the fuchsias in cemeteries which are not so well looked after.

Caterpillars: At twilight you can look for the caterpillars on their feeding plants with a flashlight. The caterpillars are quite rare in June and July but can be found much more often from August to September.



Hint: Look for them at the start of the school year in the fuchsias in cemeteries. During the day you can already find signs of them, such as **balls of excrement** and **nibbled leaves**. The caterpillars are active at twilight and at night and can be found singly. During the day they hide in a hole in the ground.

Observing the caterpillars: You can find the caterpillars from June to September. When you disturb them, they release a green, foul-smelling liquid. When the caterpillars want to threaten an enemy, the head area with two large spots like eyes blows up like a balloon. (This is used to fend off predators such as birds).

Observing the moths: You can only find the moths at twilight from June to July when they are looking for food. They prefer flowers with a long calyx such as phlox, honeysuckle, evening primrose and others. Although the pink coloured moths look more striking, you find the caterpillars more often than the moths.

For general information on keeping see Additional Materials A 1_1. In addition for this species: Keeping them is easy because these animals are quite robust. In the last stage, the caterpillar likes to hide at the base of the plant during the day. You can help this by providing a small hiding place (for example, a leaf or a piece of bark).

After pupation, the pupa should be laid on the ground and covered with moss. They only hatch **in May of the next year**. To make sure they can hatch undisturbed, only put **one animal in each hatching container** (for example a kitchen jar). **From the end of April** you can look for a change in colour of the pupa.

The ideal soil mixture to use for pupation is made of 50 % earth, 30 % fine sand and 20 % soft wood shavings. Only earth would become lumpy or become too hard. **Keep slightly moist** (spray bottle; check the amount of moisture once a week) and **watch out for mould!** If necessary, change the soil mixture.

Convolvulus Hawk-moth (*Agrius convolvuli*)

This moth with a wingspan of 8-12 cm is mostly active at night. The **proboscis** can be up to **1-3 cm long!** Because of its aerodynamic shape, it can reach speeds of 100 km/h for short periods of time. It is one of the fastest butterflies and can travel long distances. It migrates from Africa and the southern Mediterranean areas to northern Europe. It is only native in the southernmost parts of Europe but as a real migratory butterfly visits central Europe regularly. It is found in the whole of Bavaria.

Development: The first generation arrives in central Europe from May to June and the second generation develops from the middle of August until the middle of October. Because



Fig. 17: Caterpillar of the Elephant Hawk-moth threatening an enemy



Fig. 18: Convolvulus Hawk-moth (*Agrius convolvuli*)



of the climate, the second generation cannot survive unless it flies back.

The tiny, approximately 1-2 mm large eggs are blue-green when laid, but later become yellow-green. After about 8 days, 3-4 mm long caterpillars hatch from the eggs. They have a particularly long, black spine at the back. The caterpillars feed from July to September. At the beginning they hide during the day and only feed at night. Larger caterpillars also feed during the day in cloudy weather or in the shady part of the breeding container. The fully-grown caterpillars measure 10-12 cm. From August, the caterpillars look for a suitable place for pupation and are often seen on streets and paths when they are doing this. To pupate, they dig a hole about as big as a chicken's egg which is lined with cobwebby thread and lies deep (30 cm or more) in the earth. This is where pupation takes place. After about 10-14 days the approximately 5-6 cm long, mahogany brown pupa is ready. It is reddish brown and very easily recognised because of its curved and protruding proboscis. If the caterpillar pupates early enough, the moth can manage to migrate back to the country it came from. If it is too late, the pupae die off in the ground during the winter.

Caterpillars' food: The *Convolvulus* Hawk-moth prefers field bindweed (*Convolvulus arvensis*), but also eats hedge bindweed (*Convolvulus sepium*) and likes vines that are **at the edge of fields**, waste ground areas and paths.

Observing the moths: This moth is mostly nocturnal but can also be seen at twilight when it is drinking from flowers with long calyxes, like ornamental tobacco, phlox and butterfly bush

Collecting: From **June to September** you can look for caterpillars with your flashlight at night. Look on field bindweed and hedge bindweed which is growing at the edges of fields, paths and in waste areas. Signs that there are caterpillars include creepers that have been severely nibbled. During the day, it is easier to find caterpillars that are ready to pupate. From August to September they are moving around, looking for a suitable place to pupate

For general information on keeping see Additional Materials A 1_1.

In addition for this species: Only put **one animal in each hatching container**, because the caterpillars can easily injure themselves. Also, the pupae are very lively when they are hatching and can get in each other's way. Offer them a jar which is **as fresh as possible** with at least 20 cm of protected, loose earth, so that the caterpillars can dig themselves a hole. Depending on the temperature, the moth develops in 3-4 weeks.

Death's Head Hawk-moth (*Acherontia atropos*)

The caterpillar of the Death's Head Hawk-moth is an unusually beautiful one, which develops into a spectacular moth. It is called Death's Head for short. It is the **largest** moth in central Europe with a wingspan of 9-13 cm and a body length of 5-6 cm. It cannot live permanently north of the Alps. There are many things which are still unclear about the migration of this species, for example whether young moths which have grown up in central Europe fly southwards over the Alps. In central Europe, the caterpillars of the moths that arrived in early summer sometimes develop successfully, especially on potato crops.

Characteristics: The Death's Head is the only central European moth that can produce sounds which are easily heard. If you touch the ani-



mal lightly it makes sounds similar to a mouse. Also, this moth is sometimes found in beehives where it eats honey. It is therefore protected from bees by a "chemical camouflage cap".

Development: The egg rests for about 10 days. It is only up to 1.5 mm big and is a shiny green colour when it has just been laid. It quickly becomes a white-yellow colour. The horn is easily visible before hatching. The plain yellow, 6 mm long caterpillar has a strikingly large, deep black spine on its final body segment. After it has eaten its first food, it changes colour to green. After it has moulted twice it gets the typical diagonal stripes, and after the fourth moult it is yellow-green or yellow-orange coloured, occasionally dark brown. Shortly before it pupates, the 12 cm long caterpillar changes to a dirty yellow-orange colour.



Fig. 19: Death's Head Hawk-moth (*Acherontia atropos*)

The caterpillar is fully-grown for about 4-5 weeks. When you find fully-grown caterpillars you can calculate the time when the moths arrived. At about 20°C the change from caterpillar to pupa takes about a week. After 3 weeks the moths hatch.

Caterpillars' food: The most common feeding plant is the potato (*Solanum tuberosum*). The caterpillars also eat other plants of or similar to the Solanum family, such as bocksdorn (*Lycium barbarum*), Virginian tobacco (*Nicotiana tabacum*), and they can also be found on others like common privet (*Ligustrum vulgare*), the common ash tree (*Fraxinus excelsior*) and the butterfly bush (*Buddleja davidii*). Altogether the caterpillar accepts a wide range of feeding plants.

When do they fly? The moths fly from May to June and also from about September to the first half of October. The moths are strictly nocturnal. Now and then a few pupae manage to survive the winter in central Europe. But often they do not survive and so there is only one further generation a year, in August to October, beginning when the moths arrive from the south.

Collecting: From **August to September** you can find the strikingly large, yellow caterpillars in large fields of potatoes. During the day, the caterpillars stay close to the ground near yellowing leaves and on the undersides of stalks. Balls of excrement and single plants that have been eaten bare are important signs. Warm and sunny places are preferred. The pupae (cocoons) can sometimes be found on the ground when harvesting the potatoes.

Keeping of Death's Head Hawk-moth:

For general information on keeping see Additional Materials A 1_1.

In addition for this species: You can raise the caterpillars quite easily with **potato** or **privet leaves**. (Privet doesn't wilt so quickly!) They grow very quickly and it doesn't take long for them to reach 12 cm in length before pupation. This caterpillar loves sunny and dry conditions. At a constant temperature of 23°C their development lasts about 32 days. Under natural conditions they need 40-60 days until they are ready to pupate.

The caterpillar creeps around for several days looking for a suitable place to pupate. After this phase, it pupates in a 15-20 cm deep **hole in the ground**. For this, you should offer a fresh container with about



20 cm of loose soil mixture. The ideal soil mixture to use for pupation is made of 50% earth, 30% fine sand and 20% soft wood shavings. Only earth would become lumpy or become too hard. At 20°C the caterpillars need 6-7 days to change into a pupa. At 22°C they only need 4½ days. **Be careful: In particular the pupae that are not yet hard are easily damaged!**

After about 2 weeks you can take out the fully-formed pupae. To keep them from disturbing each other when they hatch, it is better to keep them singly from now on. You make a hollow in the soil several centimetres deep and flatten it out. You place the pupa in this hollow. To keep the humidity in the jar the same at all time, put on a lid which does not shut properly. **Always keep the soil slightly moist!**

Shortly before it hatches the pupa becomes **black-coloured**. Before-hand you hang long **strips of material** in the container so the moth can climb up easily. The moth hatches in autumn.

Literature

Reference Guides

Christian Stettmer, Markus Bräu, Patrick Gros, Otmar Wanninger (2007): **Butterflies of Bavaria and Austria (Die Tagfalter Bayerns und Österreichs)**. 2nd Edition. Bayerische Akademie für Naturschutz und Landschaftspflege, Laufen/ Salzach, editors – ISBN 3-931175-89-8

At the present time this is without doubt the best identification guide for use in the field. It is especially suitable for newcomers and everyone who wants to know more about native butterflies. It describes all species including their distinguishing characteristics, habitat, larval development, time they can be seen flying, their distribution as well as if they are endangered. More than 200 butterflies native to Bavaria and Austria are described and even the difficult species are made accessible. Important details are enlarged in the illustrations.

Carter, D. J. & B. Hargreaves (1987):

Caterpillars and Butterflies of Europe and their Feeding Plants (Raupen und Schmetterlinge Europas und ihre Futterpflanzen). Verlag Paul Parey, Hamburg. *This field guide describes the caterpillars of over 500 European butterfly and moth species. Coloured diagrams show the caterpillars sorted into groups according to the sort of food they eat. Identification is made easier because over 165 plants are shown together with the caterpillars that live on them.*

Sauer, Frieder (2001):

The most beautiful caterpillars identified by colour photos (Die schönsten Raupen nach Farbfotos erkannt). Schliermann-Verlag, Karlsfeld *This is a reasonably-priced book for newcomers to caterpillar identification. Butterflies and the more striking of the spinning species are well-represented. Only the more common of the moth species are pictured. The selection of looper caterpillar and small butterfly caterpillars is small.*

Bellmann, Heiko (2003):

The New Kosmos Butterfly Guide. Butterflies, Caterpillars and Feeding Plants (Der neue Kosmos-Schmetterlingsführer. Schmetterlinge, Raupen und Futterpflanzen). Franckh-Kosmos, Stuttgart.

This is a good companion on field trips for beginners with its rainproof cover. 300 central European butterflies are introduced using over 1100 brilliant colour photos. Their caterpillars, eggs, and pupae are also shown. Short explanations contain the most important points.

Weidemann, Hans-Josef and Jochen Koehler (1996):

Moths, Spinning moths, and Hawk-moths (Nachtfalter, Spinner und Schwaermer). Naturbuch-Verlag, Augsburg.

Non-fiction books

Friedrich, Ekkehard (1983):

Handbook of Butterfly Breeding (Handbuch der Schmetterlingszucht). 2nd edition, Kosmos Franckh, Stuttgart.

An excellent book about breeding butterflies, also for amateurs. You can only get it in second-hand bookshops now.



- Lange, Peter (1991):
Let Butterflies fly. Practical Ideas for Parents and Children to breed Butterflies (Lasst Schmetterlinge fliegen. Praktische Anregungen zur Schmetterlingszucht für Eltern und Kinder). – Verlag freies Geistesleben, Stuttgart.
- Reinhardt, Rolf & Kurt Harz (1996):
Migrating Moths. Death's-head Hawk Moth, Convulvulus Hawk Moth, Oleander Hawk Moth and Lime Hawk Moth (Wandernde Schwärmerarten. Totenkopf-, Winden-, Oleander- und Linienschwärmer). – Die Neue Brehm-Bücherei Bd. 596. Westarp & Spektrum, Magdeburg, Heidelberg, Berlin und Oxford.
- Fischer-Nagel, H. und A. (1990):
Colourful World of Butterflies: Peacock (Bunte Welt der Schmetterlinge: Tagpfauenauge). – Kinderbuchverlag, Luzern.
Nice colour pictures and simply understandable text. Suitable for all levels.
- Lucht Irmgard (1997):
Caterpillar Adventures. A Swallow-Tail's life (Raupenabenteuer. Aus dem Leben des Schwalbenschwanzes). – Ravensburg.
Picture book for Kindergarten and primary school.
- Reinhardt, Rolf (1984):
The Map-Butterfly (Der Landkärtchenfalter). Neue Brehm-Bücherei, Wittenberg.
- Jacobs, Una (1990):
The Butterfly Clock. Through the whole year with butterflies and moths (Die Schmetterlingsuhr. Mit Tag- und Nachtfaltern durchs ganze Jahr). – Ellermann Verlag, München.
Lovely illustrated book about the development of butterflies. Suitable for kindergarten and primary school.
- Blab, Joseph et al. (1987):
Action: Butterfly. This is how we can save them. (Aktion Schmetterling. So können wir sie retten). – Otto Maier, Ravensburg.
Shows necessary measures using beautiful pictures and photographs to save and re-create habitats (flower field).
- Bayerisches Staatsministerium für Umwelt, Gesundheit und Verbraucherschutz (2005):
Red List endangered Species in Bavaria (Rote Liste der gefährdeten Tiere und Gefäßpflanzen Bayerns) – Booklet (free).
List of all endangered species including butterflies in Bavaria and their endangered status.
- Schweizerischer Bund für Naturschutz, Hrsg. (1994):
Butterflies and their Habitats. Species – Endangerment – Protection (Tagfalter und ihre Lebensräume. Arten – Gefährdung – Schutz.) – 4th edition. Fotorotar, Egg/ZH.
- Pro Natura – Schweizerischer Bund für Naturschutz, Hrsg. (1997):
Butterflies and their Habitats. Species – Endangerment – Protection. Swiss and Adjacent Areas (Schmetterlinge und ihre Lebensräume. Arten – Gefährdung – Schutz. Schweiz und angrenzende Gebiete). Vol. 2 – Fotorotar, Egg/ZH.
- Pro Natura – Schweizerischer Bund für Naturschutz, Hrsg. (2000):
Butterflies and their Habitats. Species – Endangerment – Protection. Swiss and Adjacent Areas (Schmetterlinge und ihre Lebensräume. Arten – Gefährdung – Schutz. Schweiz und angrenzende Gebiete). Vol. 3 – Fotorotar, Egg/ZH.
Ecology and habitats are the focus of these three books. Yet, there is no comparable book. Volume 1 contains the butterflies, Volume 2 the skippers, Volume 3 the remaining families of moths (e.g. hawk-moth). The high numbers of species of moths but the low level of knowledge about their ecology diminish the capabilities of the last two volumes. Because of their good clarity, the volumes are also well suited for serious beginners – only one thing you can't do: take them into the field.

Internet addresses

www.schmetterling-raupe.de

Aide for identification of butterflies and their caterpillars. It is a project of the BUND. Supervisor is Walter Schön. This Website contains a glossary and more than 18 000 pictures of central European butterflies and moths. You can order a CD „Butterflies in schools and kindergartens (Schmetterlinge in Schule und Kindergarten)“ to get ideas for activities with Children and pupils.

www.lepidoforum.de

Aide for identification for Europe's butterfly species

www.bayern.de/lfu/natur/index.html

Red List of endangered butterflies and moths



Contacts

The Lower Conservation Authority of the District Offices and alternatively the offices of the local groups of the Society for Conservation and the State Society for the Protection of Birds can help you get in touch with local butterfly experts (for addresses see Appendix D, H and I in the Appendices of the whole publication). Willingness to support an activity with butterflies depends on the individual person. A careful enquiry is therefore appropriate. These people are often willing to provide information about butterflies and where you can best go to see them. If the experts are willing to help, they may even join in the activity and catch butterflies (with a butterfly net) for students to look at. You need experience in order to catch and successfully identify species in the field.

2. Legal Information and Handling of Butterflies

You are legally allowed to take the eggs or caterpillars of the following brush-footed butterflies: **Peacock Butterfly, Small Tortoiseshell Butterfly, Map Butterfly, Red Admiral** as well as of the **Elephant Hawk-moth, Convolvulus Hawk-moth** and the **Death's Head Hawk-moth**. The bans described in the Federal Law for Nature do not apply. (They are not specially or strictly protected species). On the grounds of animal welfare you are not allowed to damage or cause unnecessary pain to animals that you have taken from the wild.

According to the Federal Species Conservation Act (BArtSchV), the **Swallowtail Butterfly** is specially protected and therefore has a ban on taking it according to Paragraph 1, Article 44 of the Federal Law for Nature (BNatSchG). According to Paragraph 1, Article 44 of this law, it is forbidden, among other things, to "chase, catch, injure or kill specially protected animals living in the wild (...)". That means that you are not allowed to catch any specially protected species.

In Article 3 AAV, however, the following is allowed in Bavaria for purposes of education: "Teachers at state or private educational institutions according to Article 3 of the Bavarian Law for Childcare and Education, teaching staff of pre-school and childcare institutions, according to Article 2 of the Bavarian Law for Children's Care and Education, as well as staff of other institutions are allowed to use specially protected animal and plant species in their lessons **in areas such as ponds and gardens which have been created for education and training purposes**. They are only allowed to take as many animals as are absolutely necessary. As in Activity 1, butterflies and moths which are able to fly are to be let go immediately.

For the activities it is recommended that you only use **caterpillars on garden plants** (favoured feeding plants for caterpillars are fennel, common rue, carrots and dill). To take caterpillars from plants growing in the wild it is necessary to apply for an exemption from the Upper Conservation Authority of the government. You should carry this with you during the activity. You can find a sample application in Appendix B at the end of the whole publication. The governments and their addresses are listed in Appendix C at the end of the whole publication.



Handling butterflies

This advice on the careful handling and correct care of butterflies should be strictly observed and should be discussed with pupils before the activities.

Pupils should be made aware of the careful and responsible way to handle butterflies in the following ways:

- A large sign printed with "Attention! Live animals!" should remind pupils of appropriate behaviour.
- I should handle my caterpillar carefully and don't touch it with my fingers!
- I should never touch a freshly hatched butterfly with my fingers and I should never disturb it!



3. Activities

Fundamental aims of the activities

- To learn about and experience complete metamorphosis
- To accept responsibility for the development and care of an animal
- To recognise that there are connections between habitats and numbers of butterflies found

Activities

- A 1 **To experience the development of a butterfly**
To observe complete metamorphosis, the temporary keeping of a butterfly, accepting responsibility
- A 2 **To observe butterflies in their habitat**
Knowledge of species, ecological relationships, butterfly habitats
- A 3 **To experience moths “live”**
Knowledge of species, ecological relationships, light as an ecological factor

Additional material

- A 1_1 **Rules for keeping butterflies**
- A 1_2 Handout on how to find the **Peacock Butterfly**
- A 1_3 Handout on how to find the **Small Tortoiseshell Butterfly**
- A 1_4 Handout on how to find the **Map Butterfly**
- A 1_5 Handout on how to find the **Red Admiral Butterfly**
- A 1_6 Handout on how to find the **Swallowtail Butterfly**
- A 1_7 Handout on how to find the **Elephant Hawk-moth**
- A 1_8 Handout on how to find the **Convolvulus Hawk-moth**
- A 1_9 Handout on how to find the **Death’s Head Hawk-moth**
- A 1_10 **Body of a caterpillar and chrysalis**
- A 2_1 Information handout **Common butterflies in gardens I**
- A 2_2 Information handout **Common butterflies in gardens II**
- A 2_3 Information handout **Common butterflies in gardens III**
- A 3_1 Information handout **Common moths**



To experience the development of a butterfly

Factual background to the activity

This activity demonstrates complete metamorphosis in insects. Because of their size and their lack of movement, caterpillars are suitable for studying the structure of insects, and at the time of hatching this also applies to the butterflies which cannot move to begin with. At the same time you can observe their interesting habits.

When the pupils begin to look after the caterpillars they are not only practising exact observation but also how to organise themselves independently in their groups, how to accept responsibility for living animals and how to handle them. In spite of the risks you should rely on the pupils to monitor themselves.

Implementation

- Choose one of the 8 handouts on how to find butterflies. With the species that live on stinging nettles, you can use Handouts A1_2 to A1_5 at the same time.
- Make a preparatory excursion to look for eggs or caterpillars. The pupils can already be involved in this and can look in their gardens or nearby areas.
- Look for and collect caterpillars together with the pupils (the caterpillars that live on stinging nettles are most suitable). At junior high school level you can also collect the eggs of the extremely common Peacock Butterfly and Small Tortoiseshell Butterfly.
- Take about 30 caterpillars with you; but take fewer (only 4-5) of the Swallowtail and the large Hawk-moth caterpillars.
- For information on taking care of them see Additional materials A1_1
- Assign tasks: the pupils are responsible for changing the feeding plants, moving the caterpillars and writing down their observations in a report. 2-3 pupils should look after the caterpillars until the next change of feeding plants every two days.
- Adhering to the advice on handling the caterpillars is most important. Always have the rules on display next to the breeding box.
- It is very difficult to move the very young caterpillars, which are often only a few millimetres long, to fresh feeding plants (see the information in the Additional materials A1_1). The teacher should do this together with the pupils.
- The change of feeding plants on Fridays will require more plants because they have to last for the weekend.
- Talk about the structure of the caterpillars and pupae with your pupils (see Additional materials A1_10).

Season:



Grade level:



Development:



Aims of the activity

- To learn about and experience the complete metamorphosis of a butterfly
- To learn about the structure of insects
- To experience the fascination of the metamorphosis of a plant-eating caterpillar to a butterfly
- To accept responsibility for the life and the development of an animal

Materials

- To collect the caterpillars: the Handout you have chosen (Additional materials A1_2 to A1_9), gloves for caterpillars on stinging nettles, scissors, plastic container with air holes
- Breeding box with equipment and feeding plants (for a sketch see Additional materials A1_1)
- Additional material A1_1 **Rules for keeping butterflies**
- Plan for the pupils with allocation of tasks
- Report with a chronological list of all observations (change of colour and size, moulting, possibly behaviour, pupation and hatching)



Fig. 20: Caterpillar of the Elephant Hawk-moth in a defensive position. The large eyes are to frighten off predators.



Fig. 21: The orange-coloured osmeterium of the Swallowtail caterpillar becomes visible when the caterpillar is in a defensive position.

Hints for observation

- **Eggs:** Hatching of new caterpillars: Usually this happens a few days after the eggs are laid. Look for a change in colour of the eggs. Right before hatching the new caterpillar can be seen by using a magnifying glass (or even better with binoculars).
- **Caterpillars:** The process of moulting by the caterpillars, most impressive in the Hawk-moth species, changes in colour when moulting, movement (real legs, false legs and pygopodium), method of feeding, heartbeat, camouflage and warning colours.
- **Behaviour of the caterpillars when disturbed:** When touched for example with a twig: threatening poses, defence (secretions), sudden movements or falling to the ground

Please take note: The caterpillars should **not be constantly** disturbed by the pupils and kept from feeding. There can be serious problems with development if this happens.

Example of the Elephant Hawk-moth: The caterpillars secrete a green, foul-smelling juice when touched. To defend itself, the head area with two large eye spots is inflated like a balloon (defence from predators like birds). The other species are less spectacular when defending themselves.

- **Pupae:** Changes in colour and behaviour of the pupae, shape of the pupa, place of pupation
- **Method of hatching:** Look for a colour change 1-2 days before hatching
- **Freshly hatched butterflies:** lack of movement after hatching, camouflage and warning colours, structure of an insect, proboscis

Take care! Very sensitive! Do not touch!



To observe butterflies in their habitat

Factual background to the activity

You can regularly find our most common butterflies in built-up areas on “butterfly magnets” like *buddleja*, members of the Asteraceae family like hemy agrimony and on asters. These include the Peacock Butterfly, Small Tortoiseshell Butterfly, Red Admiral Butterfly, Large White (Cabbage Butterfly) and the Painted Lady. Sometimes you can also observe the Hummingbird Hawk-moth which is active during the day.

In many gardens with intensively groomed lawns and flower beds where there is not much variety of species, even common butterflies do not have much of a chance to develop. Stinging nettles and other “weeds” are greatly disliked and are removed or mown at the wrong time (when there are eggs or caterpillars on them). So you can mostly observe butterflies in gardens that are not well looked after and which have many native plants, and in other areas which are not so well cared for, such as the edges of paths or roads.

Implementation

- Choose a day with **sunny, warm (>20 °C)** weather with as little wind as possible, between June and September. The best time is before midday.
- Look for butterfly bushes (*Buddleja*) or large areas of hemy agrimony and members of the *Asteraceae* family like autumn asters that are in full bloom. The more flowers there are, the more attractive they are. Encourage the pupils to look for butterflies in their own gardens.
- A class outing is ideal for holding a butterfly finding competition.
- Use the Identification Handouts (see Additional materials A 2_1 to A 2_3) to identify the butterflies and count them. A butterfly identification book is also useful.

Hints for observation

- **Butterflies:** They suck with their long proboscis. For the Peacock Butterfly: butterflies with their wings closed can be encouraged to show the large eye spots by slowly moving your finger towards them from behind. They suddenly open their wings and the spots are visible (this frightens away possible predators).
- **Evaluating the suitability of the environment for butterflies:** Look for the corresponding feeding plant (it is usually not there). What does our garden/the schoolyard look like? Which plants should we have in order to attract butterflies?

Season:



Grade level:



Development:



Aims of the activity

- To recognise the connection between the availability of feeding plants (caterpillars) and nectar plants (butterflies)
- To evaluate the suitability of the (school) environment for butterflies
- To learn about how to encourage butterflies

Materials

- Additional material A 2_1 to A 2_3 **Identification Handouts Butterflies**
- In addition, a butterfly identification book (for example Stettmer et al 2007)



Fig. 22: Peacock Butterflies on a butterfly bush



To experience moths “live”

Factual background to the activity

Moths and other insects that are active at night are strongly attracted by lamps with a high proportion of ultraviolet (white) light. The high proportion of UV light covers the naturally available, softer light and makes the moths lose their sense of orientation. This causes the moths to fly directly toward the source of light. This can attract some moths from a distance of up to 500 m away. This is why you often see moths and other insects that are active at night flying around lamps or streetlights on warm summer nights. They cannot find their way out of the light again. You can use this effect for the following experiment by building a “light trap”.

Increasing “light pollution” – artificial light sources in our towns (streetlamps, garden lanterns etc) – is a danger particularly for moths. They are attracted by street and garden lighting and stay the whole night near these sources of light. The next day they are either eaten by birds or die of malnutrition.

Implementation

- Choose a **warm summer night (>20 °C)** from the middle of **July** until **September**.
- At twilight, choose a clearly visible place (for example, edge of the town, small hill) with nectar plants (butterfly bushes, honeysuckle, phlox, asters, large members of the *Asteraceae* family and others) nearby, and fix two neon tubes vertically to a pole.
- Put a gauze or mosquito net around the lights (strengthen it with thin wire if necessary) at a distance of 15-20 cm. (See Fig. 23).
- As soon as it gets dark, use an extension cord to get electricity (possibly from a car battery)
- Moths that have been attracted by the light sit on the net and stay there as long as the light is shining. As soon as the light is turned off, they fly away again.
- It is good to test the place you have chosen a few nights before the activity. Then you can check the insect population and make an estimate whether there are enough moths and other insects in the area that can be attracted.

Season:



Grade level:



Development:



Aims of the activity

- To experience moths in their habitat
- To recognise the connection between finding moths and finding their feeding plants

Materials

- 2 neon tubes, as long as possible
- A 1.5-2 m long pole or similar to attach the neon tubes to
- Extension cord for the electricity connection
- Gauze or very fine net (1-2 mm holes), that can for example be strengthened with wire. It must be hung at a distance of 15-20 cm from the neon tubes. The net must fully surround the neon tubes; otherwise the insects could injure themselves. Instead of building this yourself, you can buy a moth light trap.
- Additional material A3_1 **Identification handout moths**



Fig. 23: This moth activity shows the surprising diversity of insects that are active at night.



Hints for observation

- The moths which are sitting on the net and also a large number of other insects which are active at night can be observed.
- The moths can be identified with the Identification Handout (Additional materials A 3_1). With all the other insects you should just identify to which of the main insect groups they belong to.



Rules for keeping butterflies

Breeding box

- To stop the caterpillars from crawling away, you must have a **breeding box** like the one shown in the picture. There should be enough space inside for the feeding plants and water. At least one side must **let air pass through** (use fine net or gauze) and for observation purposes at least one side should be transparent. You can also use a 10 litre plastic bucket which is available in a transparent version. You can also use airy gauze boxes or roomy preserving jars with a wide opening, which you can easily put your hand into.
- The container should be put in a **well-lit place** but **not in direct sunlight**. The caterpillars will develop best if the **room temperature is over 20°C**.

Cleaning

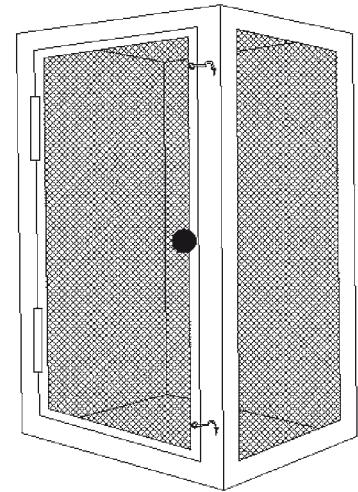
- Put **absorbent paper** (kitchen towels) on the floor of the container. When you clean the box, you can remove the paper and the balls of excrement with it. **Cleanliness is the first rule when keeping butterflies!** If the excrement is left it could get mouldy and this could infect the caterpillars with bacteria and fungi. There should also **not be any condensation** in the breeding box (danger of fungus infection).

Feeding

- To keep the feeding plants fresh, they are put in a container of water in the breeding box. The water container for the feeding plants must be **covered with material!** The caterpillars could otherwise crawl up the container, fall inside and drown. It is also possible to cover the top with cotton wool or you can make holes in the metal lid of a glass jar, through which you put the stems of the plants.
- The leaves of the feeding plants **must not be wet**, to avoid condensation.
- Change the feeding plants **every two days**, at the latest on the third day. Over the weekend you need to give more food. Old feeding plants are removed as soon as there are **no more caterpillars** on them.

Handling of the caterpillars

- **Never touch** the caterpillars **with your fingers!** To move them it is best to push them onto a piece of paper or cardboard with a soft brush.
- **Under no circumstances should you help the caterpillar with moulting!** You can, however, carefully remove the pieces of skin left by moulting with small tweezers. Moulting is quite risky for the caterpillar. The most difficult part is releasing the skin on the head. The caterpillar is particularly defenceless when moulting and must not be disturbed. If it is touched by people or by other caterpillars or stays for too long in the old skin it will die.



Breeding box with side doors makes working with them easier.

Wash your hands every time you come in contact with the caterpillars and their containers!



Please observe the following in the case of butterflies

- When the caterpillars become restless, leave their fresh food and crawl around their box, offer them **thin twigs or sticks** for them to use during pupation. These should be placed every which way around the breeding box and **not too near** each other. After pupation it lasts about 3 weeks until the first butterfly hatches.
- When the last caterpillar has pupated, remove all the feeding plants with the water container. Put new paper on the floor.
- **A butterfly does not always hatch!** Sometimes the caterpillars of butterflies have parasites, especially when you have collected older caterpillars. Light-coloured larvae like maggots hatch from these caterpillars, and they mostly pupate immediately.
- Shortly before hatching, the pupae **change colour** and you can see the **pattern of the wings** through the pupa. The best time for hatching is in the early morning.
- Leave the freshly hatched butterflies in the dark over night and only let them **fly off the next day**.

Please observe the following in the case of moths

- When the caterpillars become restless, leave their fresh food and crawl around their box they need a container filled with **fresh earth for pupation**. A mixture of 50 % soil, 30 % fine sand and 20 % soft-wood sawdust is ideal. Soil only goes lumpy and becomes hard. You can also use peat soil.
- Pupae which have not become hard yet can **easily be injured**. You can only take the pupae out of the container **after about two weeks**.
- Now each pupa needs its **own container for pupation**, to avoid the animals injuring each other during hatching.
- A **cover which does not close completely** is laid over each pupation container to keep the humidity more or less the same.
- The soil is **always kept slightly moist** with a spray bottle. Check the moisture once a week.
- **Watch out for mould!** If necessary, change the soil.
- Shortly before hatching, the pupae **change to a dark colour** (a black colour in the case of Death's Head and Convolvulus Hawk-moths). When this happens, hang long **strips of material** in the container to make it possible for the moths to climb up.
- The best time for hatching is in the early morning. Leave the freshly hatched moths in the dark over night and only let them **fly off the next day**.
- The Elephant Hawk-moth only hatches in May of the following year. **From April onwards** look for a change of colour in the pupa.



Handout on how to find the Peacock Butterfly



Eggs of the Peacock under some stinging nettle leaves



Nest with young caterpillars



Pupa



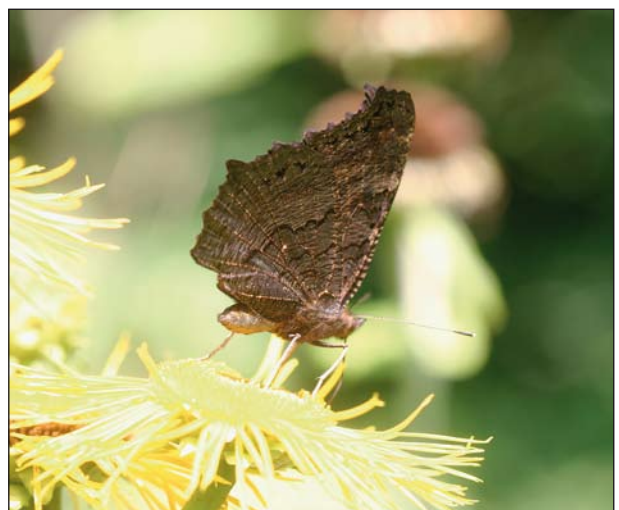
Adult caterpillar



A hatching Peacock



Butterfly



Butterfly, under wing



Handout on how to find the Peacock Butterfly

Time: **End of April to May.** Take the youngest caterpillars you can find, because the chances of them being infected with parasites are smaller.

Materials: Gloves, scissors, plastic container with air holes

How to look:

- On **large** clumps of stinging nettles (*Urtica dioica*) in a sunny and somewhat humid area at stream banks and near ditches. Watch out for **pale grey clumps of cobwebby material** (communal webs), **nibbled leaves** or nettles which have been **eaten away to the stem**.
- **Gloves** (stinging hairs) and **scissors** to cut the plants are recommended.
- Hold the open **plastic container** under the stinging nettle with the caterpillar and cut off that part of the plant. (Many caterpillars roll up when they are disturbed and let themselves fall to the ground). If necessary you can also use a plastic bag but be very careful that the caterpillars do not get squashed afterwards.
- It is best if you take about **30 caterpillars** from several different stinging nettle plants.



Handout on how to find the Small Tortoiseshell



A Small Tortoiseshell during oviposition



Nest with young caterpillars



Pupa



Adult caterpillar



Butterfly



Butterfly, under wing



Handout on how to find the Small Tortoiseshell Butterfly

Time: **End of April to May.** The young caterpillars are not infected with parasites so often at this time of year.

Materials: Gloves, scissors, plastic container with air holes

How to look:

- Look on stinging nettles (*Urtica dioica*) on sunny areas of slopes. Watch out for **pale grey clumps of cobwebby material** (communal webs), **nibbled leaves** or nettles which have been **eaten away to the stem**. The very young, pale yellow caterpillars all stay very close together before their first moulting. After the first or second moulting the communal webs are more noticeable and are to be found lower down on the stinging nettles.
- **Gloves** (stinging hairs) and **scissors** to cut the plants are recommended.
- Hold the open **plastic container** under the stinging nettle with the caterpillar and cut off that part of the plant. (Many caterpillars roll up when they are disturbed and let themselves fall to the ground). If necessary you can also use a plastic bag but be very careful that the caterpillars do not get squashed afterwards.
- It is best if you take about **30 caterpillars** from several different stinging nettle plants.



Handout on how to find the Map Butterfly



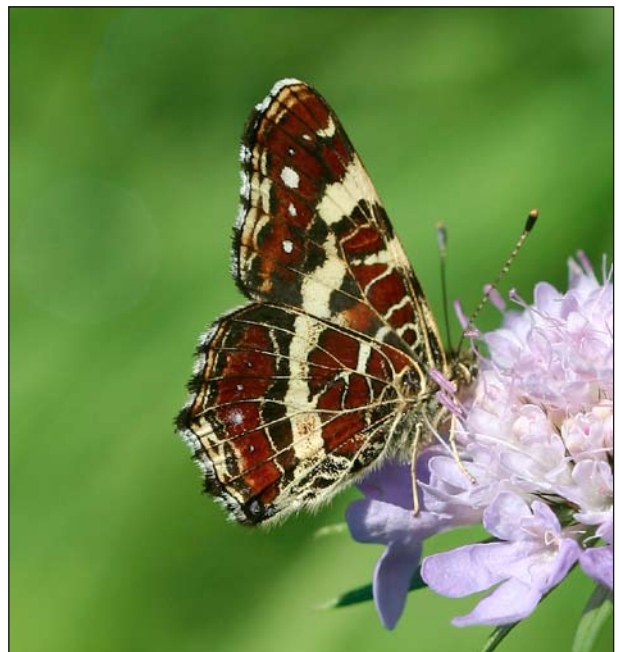
Butterfly during oviposition; the „egg towers“ are typical



Adult caterpillar



Pupa



Under wing



Bright spring variant of the Map Butterfly



Dark summer variant of the Map Butterfly



Handout on how to find the Map Butterfly

Time: End of May und June.

Materials: Gloves, scissors, plastic container with air holes

How to look:

- Look on stinging nettles (*Urtica dioica*) in shady areas with high humidity like damp areas of tall herbaceous vegetation, wetlands, sparse forest and transition moors. Watch out for **pale grey clumps of cobwebby material** (communal webs), **nibbled leaves** or nettles which have been **eaten away to the stem**.
- Only collect the caterpillars, not the eggs. (The eggs need to be kept in very high humidity).
- **Gloves** (stinging hairs) and **scissors** to cut the plants are recommended.
- Hold the open **plastic container** under the stinging nettle with the caterpillar and cut off that part of the plant. (Many caterpillars roll up when they are disturbed and let themselves fall to the ground). If necessary you can also use a plastic bag but be very careful that the caterpillars do not get squashed afterwards.
- It is best if you take about **30 caterpillars** from several different stinging nettle plants.



Handout on how to find the Red Admiral Butterfly



Eggs



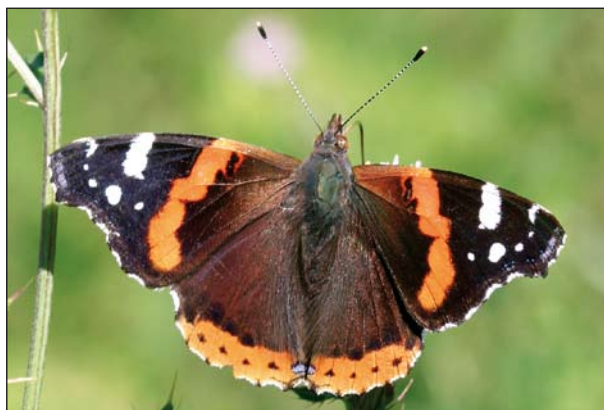
Caterpillar



Pupa



Butterfly, under wing



Butterfly



Handout on how to find the Red Admiral Butterfly

Time: In **June**. In Bavaria there is only one generation from June to October.

Materials: Gloves, scissors, plastic container with air holes

How to look:

- Look on semi-shady areas of stinging nettles in a moderately damp microclimate. The caterpillars can be found **singly** in typical **rolled up leaves** spun with cobwebby threads. The stem of the leaf has often been nibbled and the leaf **hangs downwards**.
- **Gloves** (stinging hairs) and **scissors** to cut the plants are recommended.
- Hold the open **plastic container** under the stinging nettle with the caterpillar and cut off that part of the plant. (Many caterpillars roll up when they are disturbed and let themselves fall to the ground). If necessary you can also use a plastic bag but be very careful that the caterpillars do not get squashed afterwards.
- It is best if you take up to **10 caterpillars** from several different stinging nettle plants.



Handout on how to find the Swallowtail Butterfly



Yellowish coloured eggs of the Swallowtail



Caterpillar with an everted osmeterium



Adult caterpillar



Pupa



Butterfly



Handout on how to find the Swallowtail Butterfly

Time: From the start of June.

Materials: Scissors, large plastic bag

How to look:

- Because the Swallowtail only lays a few single eggs on one feeding plant, **it is not recommended to look for eggs as this is very difficult.** The **caterpillars** are found on the leaves and flowers of the **Umbellifer family** and on **common rue**. Looking for the caterpillars which live by themselves is very time-consuming. It is best to be content with about 4-5 caterpillars.
- Particularly attractive feeding plants are **fennel** (*Foeniculum vulgare*), **wild carrots** (*Daucus carota*), **common rue** (*Ruta graveolens*), and **parsnips** (*Pastinaca sativa*).
- Look on plants in areas in **full sun**, somewhat **protected from the wind**, which are standing at the **edges of groups of plants** and which are **taller than the others**.
- Hold the open **plastic container** under the stinging nettle with the caterpillar and cut off that part of the plant. (Many caterpillars roll up when they are disturbed and let themselves fall to the ground). If necessary you can also use a plastic bag but be very careful that the caterpillars do not get squashed afterwards.

Important note: Always keep feeding with the same plant which the caterpillar was found

- The caterpillars in the wild which are found on self-sown members of the Umbellifer family, for example, wild carrots, caraway, and *Peucedanum* species (flowering plants in the carrot family), are **protected by law** and **may only be collected with an exemption permit** (Application in Appendix B at the end of the whole publication).



Handout on how to find the Elephant Hawk-moth



Caterpillar



Threatening caterpillar



Pupa



Moth, under wing



Moth



Handout on how to find the Elephant Hawk-moth

Time: **June to September.** The caterpillars are still quite rare in June and July, but much more common from August to September. Hint: look for them at the beginning of the school year.

Materials: Torch, scissors and a large plastic bag

How to look:

- Look on **willowherb** plants (*Epilobium hirsutum*, *E. parviflorum*, *E. angustifolium* and others), also bedstraw (*Galium*) and balsam plants (*Impatiens*). You can most easily notice the caterpillar when it has stripped the leaves of fuchsias (*Fuchsia*), especially on the fuchsias in cemeteries which are not so well looked after.
- Look for the caterpillars with a torch **at twilight** on their feeding plants. Important signs of them can already be found during the day – the **balls of excrement** lying on the ground and **feeding sites**. The caterpillars are active at twilight and at night and can only be found **singly**. During the day they hide in a hole in the ground.
- A few caterpillars are sufficient.



Handout on how to find the Convolvulus Hawk-moth



Adult caterpillar



Adult caterpillar in top view



Pupa with a snoutlike process



Moth, upper wing



Moth, side view



Handout on how to find the *Convolvulus* Hawk-moth

Time: June to September.

Materials: Torch, plastic container with air holes

How to look:

- Look for the caterpillars **at night** with a **torch**. Look on **field bindweed** and **hedge bindweed** found in the overgrown edges of fields, beside paths and in waste ground areas.
- **Severely nibbled Bindweed plants** show where the caterpillars are to be found; especially field bindweed (*Convolvulus arvensis*) but also hedge bindweed (*Convolvulus sepium*).
- It is easier to find the caterpillars which are ready to pupate. From August they are crawling around looking for a place to pupate.
- A few caterpillars are sufficient. You can collect them by hand.



Handout on how to find the Death's Head Hawk-moth



Caterpillar of the Death's Head Hawk-moth after the third moulting



Fully-grown caterpillar



Pupa



Moth

Time: June to September

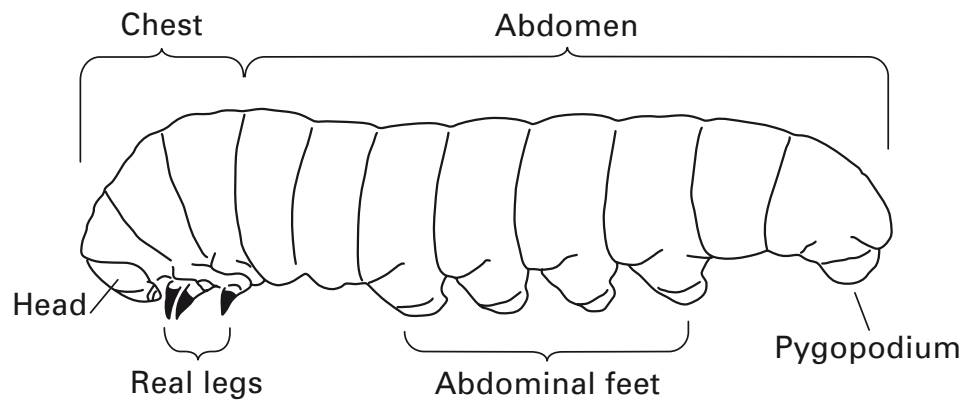
Materials: Torch, scissors, plastic container with air holes

How to look:

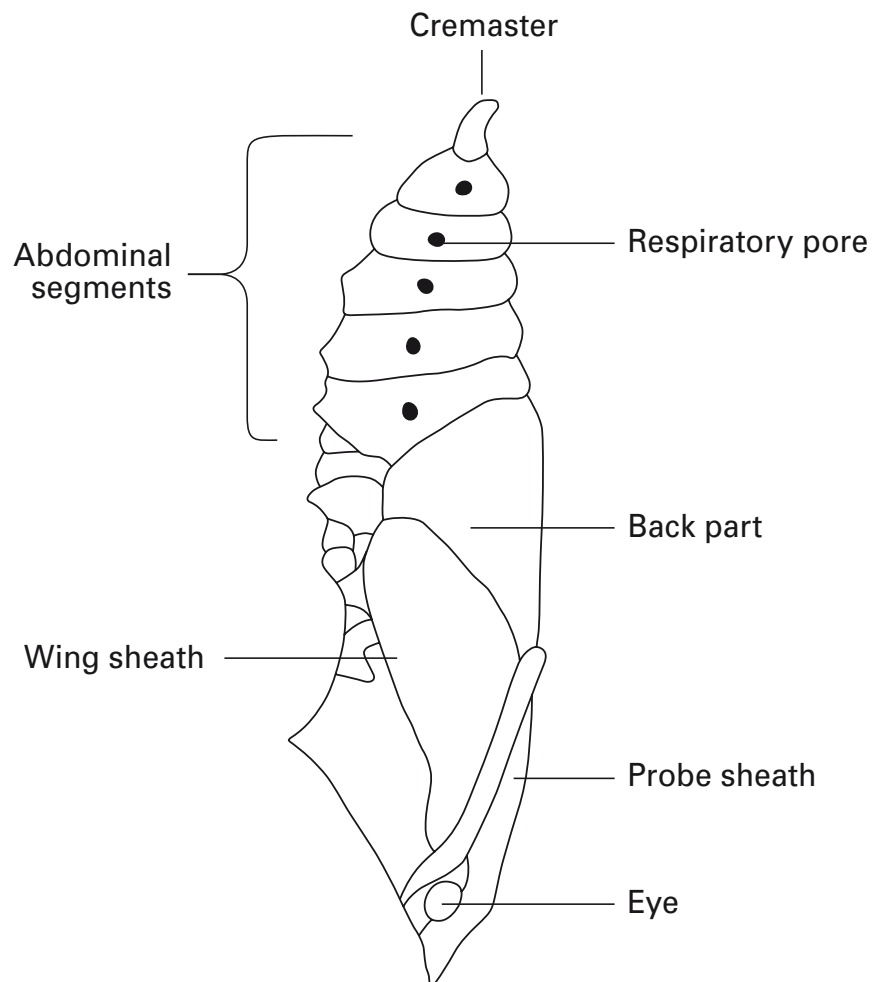
- In fields of potatoes where pesticides have not been used much, look for potato plants that have been **stripped of their leaves**. During the day, the caterpillars stay **just above the ground** near yellowed leaves on the **underside of the stems**.
- Alternatively you can look **at night** with a **torch** for the strikingly large caterpillars on the plants which have been eaten.
- You can also look on other plants of the Nightshade family like bocksdorn (*Lycium barbarum*), cultivated tobacco (*Nicotiana tabacum*), and also species from other plant families like privet (*Ligustrum vulgare*), european or common ash (*Fraxinus excelsior*), and the butterfly bush (*Buddleja davidii*).
- When the potatoes are being harvested you can occasionally find the pupae (*pupa obtecta*, where the appendages are closely bound to the body) on the ground.
- A few caterpillars are sufficient. You can easily collect them by hand.



Body of a caterpillar and chrysalis



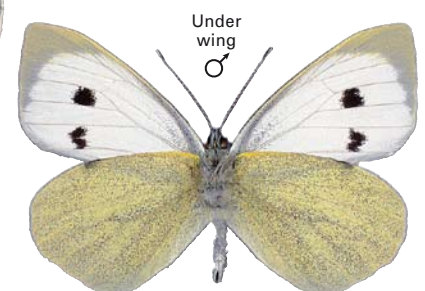
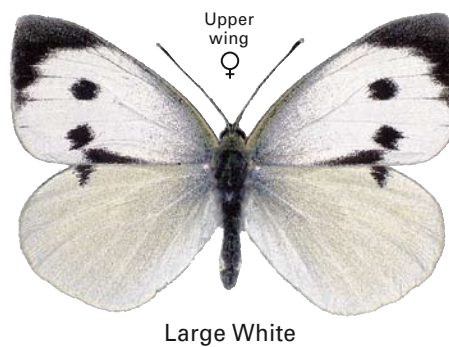
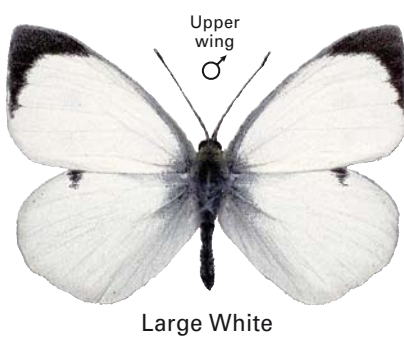
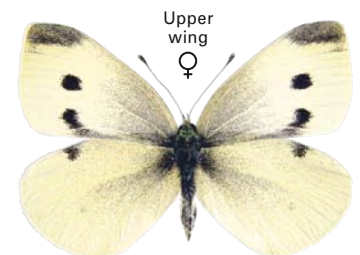
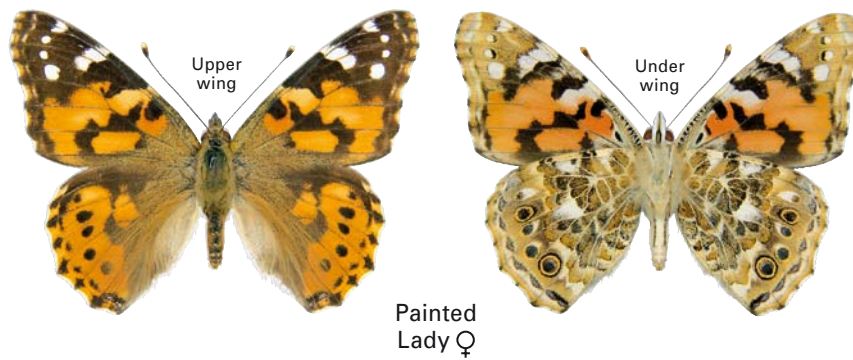
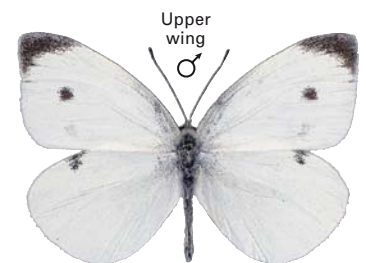
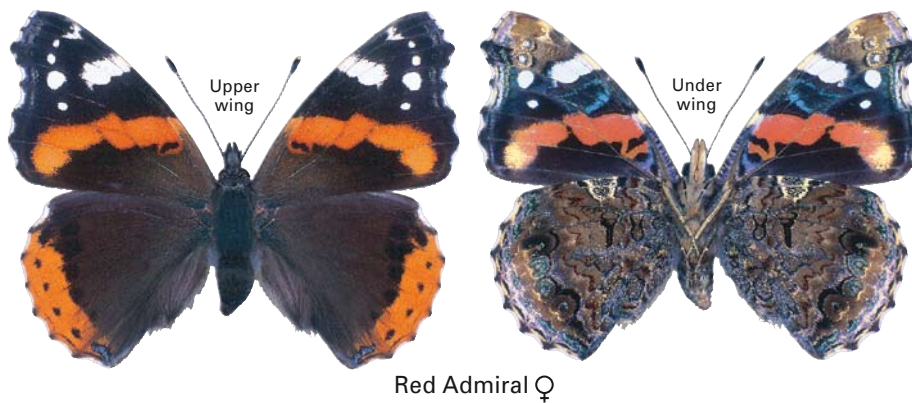
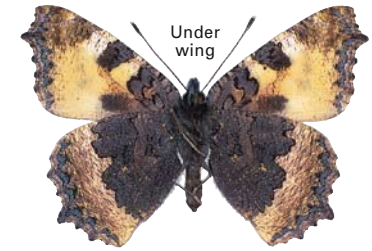
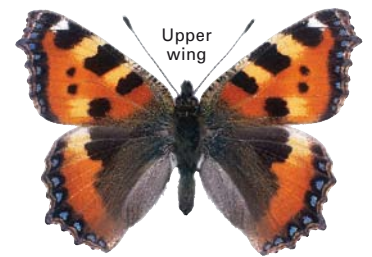
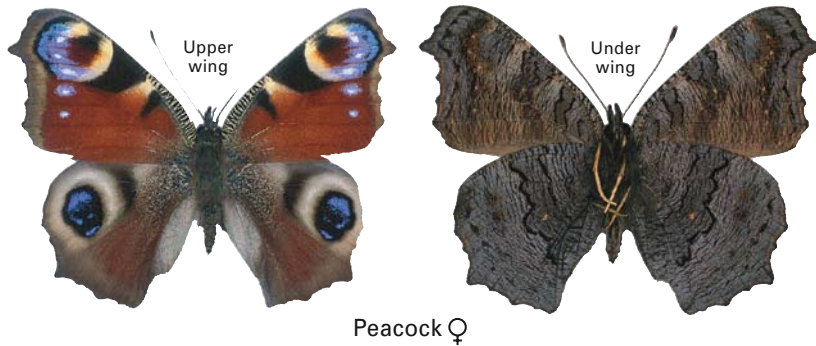
Physique of a butterfly's caterpillar. Moths mostly have got a more or less big sized after horn on the top of the last segment.



Upside-down hanging pupa of the Small Tortoiseshell



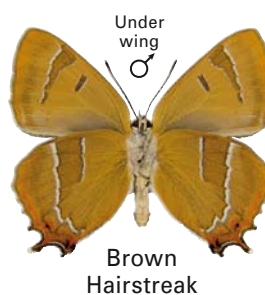
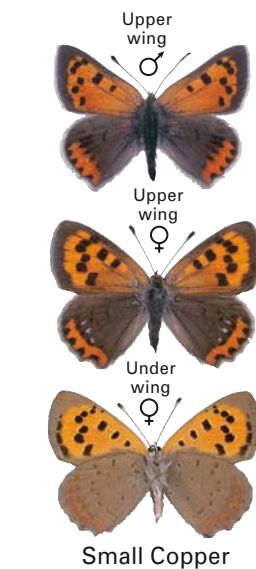
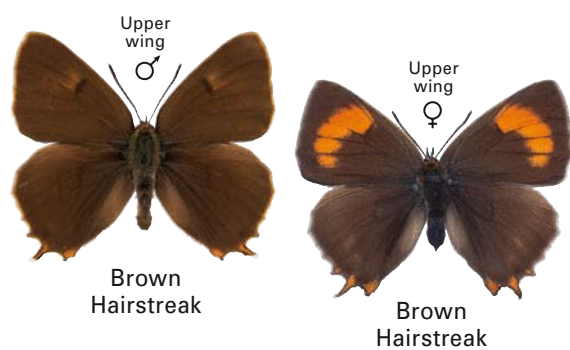
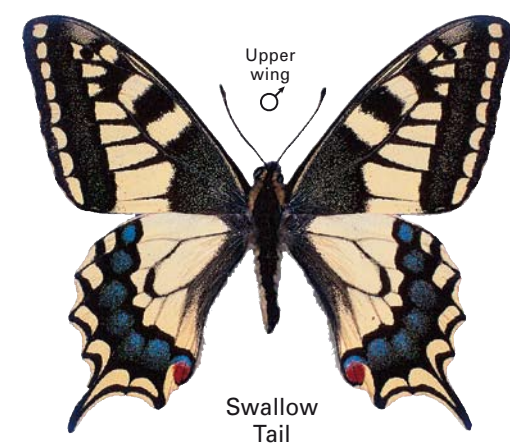
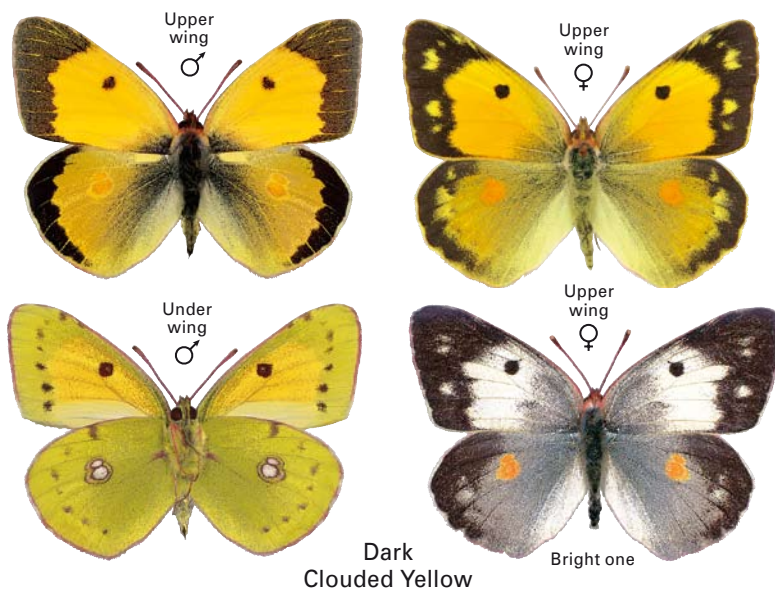
Common butterflies in gardens I



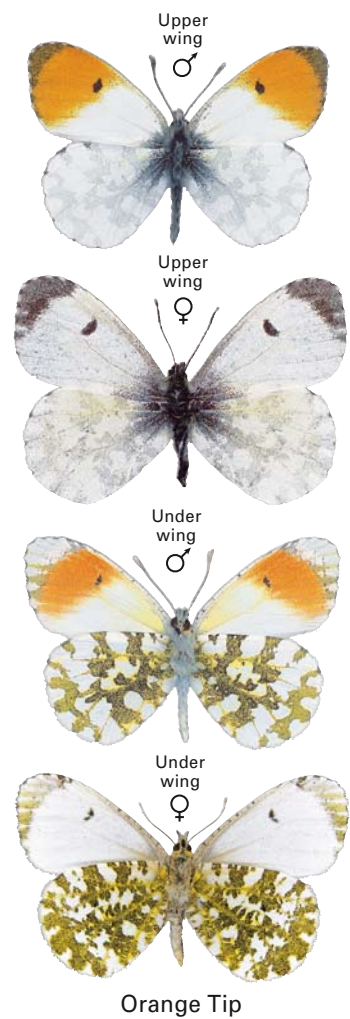
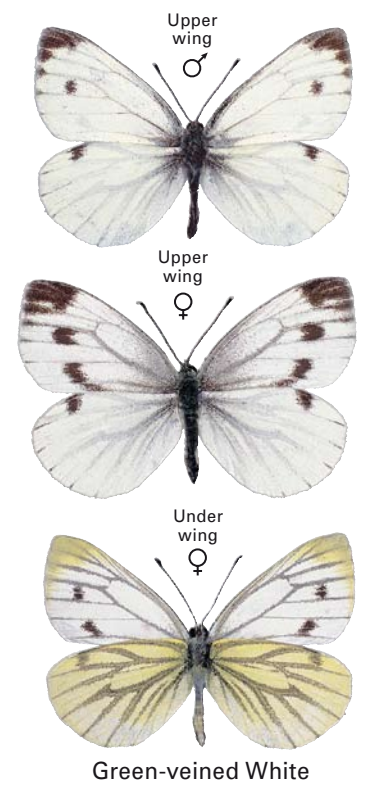
Figures in original size



Common butterflies in gardens II

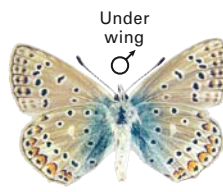
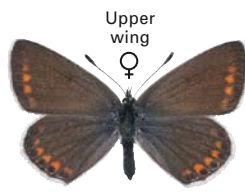
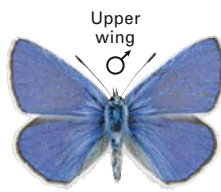


Figures in original size

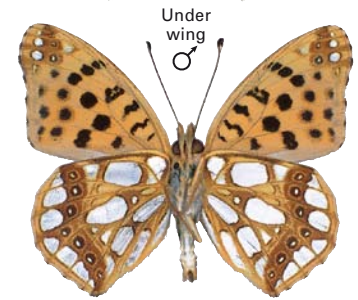
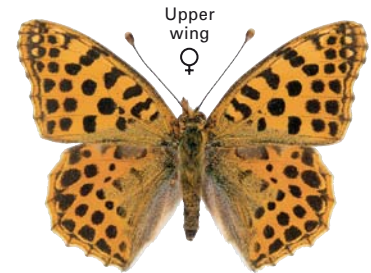




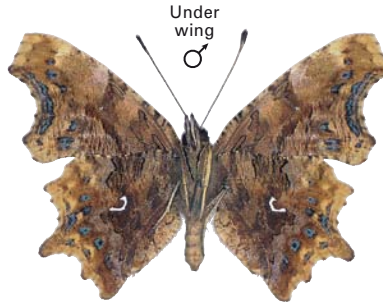
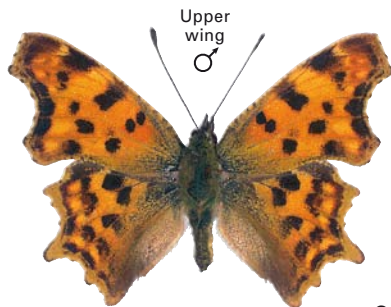
Common butterflies in gardens III



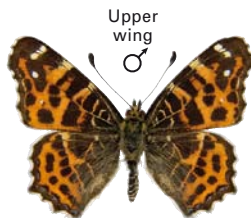
Common Blue



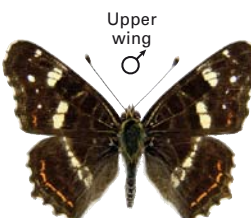
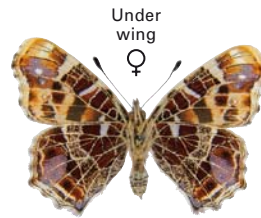
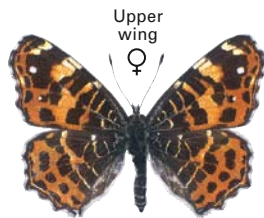
Queen of Spain
fritillary



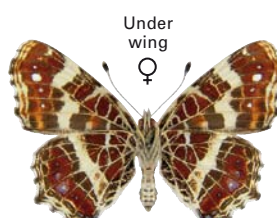
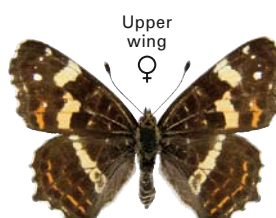
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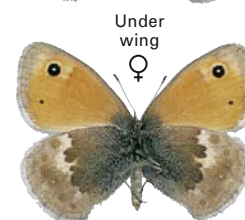
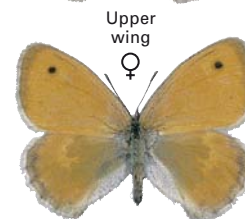
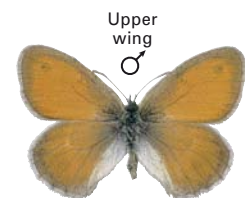
1. Generation



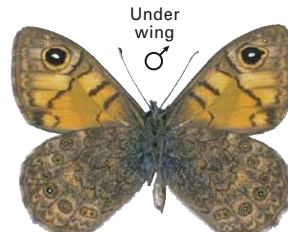
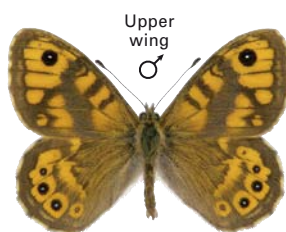
2. Generation



Map



Small Heath



Wall Brown



Hummingbird Hawk-Moth ♂
(Exclusively diurnal moth)

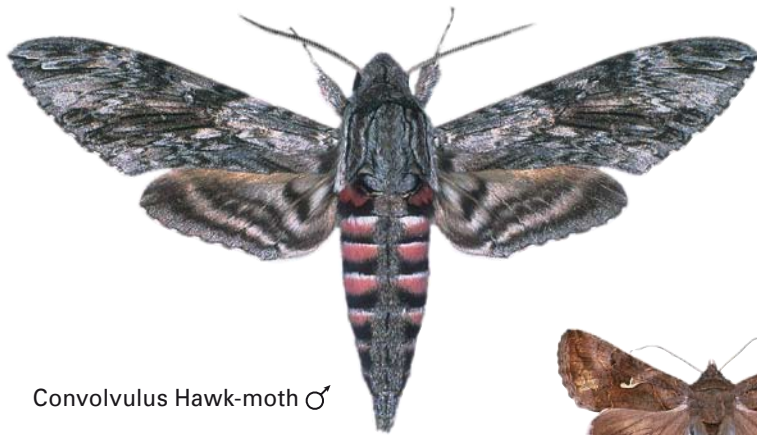


Gammfly ♀
(Diurnal and nocturnal
moth)

Figures in original size



Common moths in gardens



Convolvulus Hawk-moth ♂



Elephant Hawk-moth ♂



Gammafly ♀
(Diurnal and nocturnal moth)



White Ermine ♂



Large Yellow ♀
Underwing



Buff-tip ♀



Buff Ermine ♂



Herald ♀



Swallow Prominent ♀



Iron Prominent ♂

Figures in original size

