

WHAT IS A BUTTERFLY?

- Some people call them flying flowers or flying jewels. The Ancient Greeks believed that butterflies were the souls of the dead flying to heaven.
- Butterflies are insects, but whereas almost everybody finds a butterfly beautiful, this isn't true of other insects like wasps, beetles or mosquitoes. Unlike these insects, the butterfly has no bite or sting, it is a model of innocence.
- Insects belong to the largest division (or phylum) of the animal kingdom. This phylum is called the Arthropods.
- Arthropods have a segmented body and jointed limbs. Included in this division are: Crustacia (lobsters, crabs, woodlice), Arachnids (spiders, scorpions, mites, harvestmen), and Centipedes.
- Insects, however, are the largest and most richly varied group within this diverse division of the animal kingdom. No less than 70% of over 1 million described arthropods are insects.
- The main features of insects are: **[How many legs?]** 6 legs, 1 pair of antennae, and a segmented body, head, thorax and abdomen.
- Insects are also sub-divided into 30 so-called Orders, mainly based on wing features. These orders include Coleoptera (beetles), Hymenoptera (bees, wasps & ants), Orthoptera (grasshoppers, crickets) and Lepidoptera (butterflies and moths).

Lepidoptera

- After Coleoptera (the beetles), Lepidoptera form the order with the largest number of species. ***[Guess how many species of butterfly there are?]*** 16,000 have been described, with more still being discovered.

- Lepidoptera have always been distinguished into butterflies and moths based on the shape of their antennae.

- Lepidoptera with threadlike antennae ending in a small club are butterflies, those with differently shaped antennae e.g. feathery, are classified as moths. ***[Make arms into antennae]***

- Most butterflies are brightly coloured and active during daytime, whereas moths have dull colours and are active at night. However, this is a rule with many exceptions.

Build - Caterpillar

- The body of a caterpillar is built very simply. It consists of no more than a head with 13 segments behind.
- The most striking feature of the head is the large jaws which are used to chew and eat large amounts of food.
- Between the jaws are glands that produce a liquid from which silk can be made. On both sides of the jaws are two small antennae with simply constructed eyes, called ocelli.
- The next 3 segments (thorax) have 3 pairs of legs used for grasping the food.
- The remaining segments are those of the abdomen which have 4 pairs of false or pro-legs, which end in a contractile pad surrounded by a ring of hooks. The last segment has the large hind pro-legs or claspers.
- With all these legs the caterpillar can walk very well and hold on tightly to a plant.

- On the side of the caterpillar can be seen small holes (spiracles). These are tubes which form part of the caterpillar's breathing mechanism.

- Depending on the species, caterpillars have a body which is either bald, hairy, spiny or with tails.

Build – Butterflies & Moths

- Butterflies and moths also have a head, thorax and abdomen. The head contains some remarkable organs. ***[Can you name any organs of the head?]*** The most prominent are the antennae, the proboscis and the compound eyes.
- The antennae on each side of the head contain delicate nerve cells which function as highly sensitive organs of smell.
- The antennae are also used for balancing and as feelers.
- With their sensitive antennae, Emperor Moths can smell a female from a distance of many miles. They have the most sensitive noses in the animal kingdom.
- The proboscis consists of two elongated half tubes which form a tubular sucking and licking organ. Towards the end it forms a narrowing capillary which is split at the tip. When not in use it is coiled in a spiral.
- Because butterflies and moths have no jaws to bite and chew with, they must rely on liquid food, the most important being nectar.
- ***[Can you think of anything else they might like to drink?]*** Some also like the juice of rotting fruit, dead animals, manure and urine.
- Heliconias sometimes collect pollen which sticks to the proboscis. They make the proteins of that pollen soluble and then suck it up

their proboscis. In this way they are able to gain more nutrition and so enabling them to live longer.

- The size of the proboscis varies in size from not even a centimetre to 15 centimetres.
- The compound eyes are made up of between 12 – 17,000 separate optical units called ommatidia. The butterfly sees its surroundings as a mosaic of tiny pictures. They have excellent vision, especially over shorter distances, flying expertly in difficult surroundings, full of obstacles. They can detect a limited number of different colours and are also capable of detecting ultraviolet light.
- The thorax consists of 3 segments largely filled with muscles. The forelegs are attached to the 1st segment, middle legs and a pair of forewings to the 2nd, and a third pair of legs and hindwings to the 3rd.
- The wings are covered with small scales, arranged like roof tiles, are hollow and contain pigments.
- The morphos do not only depend on the pigment but also on the structure and arrangement of the scales. A special form of light refraction is created giving the wings a metallic glow.

➤ The abdomen is composed of 10 segments, the last 2 or 3 are fused together as a genital organ. Males have pincer shaped projections with which they grasp the female while mating. Females have an ovipositor with which they lay eggs. The females also have glands in the abdomen that produce sex pheromones used to attract males.

➤ Some butterflies have special colour varieties. These can be mutants that lack a certain colour pigment, eg where a butterfly has white wings instead of orange. A very special anomaly is the gynandromorphy. This means the left half of the insect is male and the right half is female. The development occurs in the fertilised egg. This can contain two nuclei, a male and a female, or a cell with one nucleus in which an error has occurred during one of the first cell divisions. The end result being a gynandromorphy. Such butterflies remain hidden from the human eye when the wings of the male and female are the same, but for those butterflies where the male and female have their own colour pattern, a gynandromorphy can be spotted immediately. The frequency of this happening has so far been determined as 1 in 90,000.

Life Cycle

- Butterflies and moths belong to the winged insects. These can be divided into two large groups: insects with an incomplete metamorphosis and insects with a complete metamorphosis.

➤ The incomplete metamorphosis is where the larvae which has hatched from the egg already looks like a mature adult. They are just smaller and in the larval stage do not yet have wings. The larva grows with each skin change or sloughing and at the final sloughing, gets its wings and is now a fully grown adult. There is no distinct pupae stage. Grasshoppers, stick insects and dragonflies have a similar life cycle.

- The complete metamorphosis is where the larvae crawl from the egg and do not look like the mature adult at all. Think of a maggot which becomes a fly and of course the caterpillar which becomes a butterfly or moth. The larva sloughs several times and gets bigger each time. At the final sloughing it becomes a pupa. At this stage the insect goes through the metamorphosis from a larva to a mature winged adult. Beetles, wasps and flies also belong to this group of insects.

- So the life cycle is as follows: **[Ask?]**

Butterfly/moth --- egg --- caterpillar --- pupa --- butterfly/moth --- etc

Attraction

- **[How long do you think they live?]** The lives of butterflies and moths are very short. Most only live 2 or 3 weeks. In this short time they must produce offspring.
- The first step is to find a mate. This may not be easy as there are more than 160,000 different species which are often very similar.

➤ So, to find a mate the female sits in a strategic spot and releases an aromatic substance called sex pheromones.

- Each species has its own characteristic odour. Butterflies recognise each other first of all by their external appearance, and in a certain place such as a hilltop, a single tree or an open space in the woods, males fly madly about throwing themselves at females that resemble its own species. When it finds a suitable candidate the courtship begins.

➤ Some males fly under the female, other hover and dance above the female. While dancing he waves sex pheromones at his partner. The female is only stimulated to mate by the scent of the male of her own species. If another species should try she would take on a defensive attitude with her abdomen.

- If the male and female have made it clear by scents and colours that they belong to the same species then they begin to mate. They start with the coupling of the external sex organs. They can stay together for many hours, even a whole day. During copulation the male passes on sperm cells and also certain proteins to the female. She uses them for the production of her eggs. The male may also give off an aromatic substance as well, so making the female less attractive to any passing males.

Egg

- Mating finished, the males go after more females and the freshly mated female goes in search of a plant on which to lay her eggs.
- Butterflies have a strong preference for plants belonging to a certain species. These 'host' plants are recognised by the female with the aid of the sensilla on her legs. She may gently tap the leaves of the plant or simply walk on them and can judge whether the plant is a suitable food plant and start egg laying.
- The size of the eggs varies from a few tenths of a millimetre to almost half a centimetre. Some are laid singly, some in groups, rows, ringlets and chains.
- The egg shell is hard and can be smooth or have ridges, and are ball, cone, cylindrical or disc shaped. The embryo develops in the eggs. This can take a few days to sometimes weeks.
- Eggs often change colour just before hatching. The eggs are usually laid under the leaf (but not always). They are glued to the plant with a sort of collagen (gelatine). They are now safe from the rain and cannot be washed off.
- ***[What other dangers face the eggs?]*** Perhaps their biggest enemy at this stage are ants who can remove them and take them off to their nest.

Caterpillar

- On emerging from the egg the caterpillar will eat the eggshell. They will then continue to eat the plant they are on.
- Despite their huge appetite, caterpillars are extremely choosy. If they cannot find the correct food plant they would starve rather than try another plant. The caterpillar eats large amounts of leaves.
- To be able to grow the caterpillar sheds its skin a number of times, because the skin is not elastic. **[Think of the Incredible Hulk – his clothes split when he grew bigger!]** It gorges itself and at a certain stage will need a wider jacket. The caterpillar seeks a sheltered spot and spins a silk thread and fastens its abdomen to the plant. Its skin tears open at the front and the caterpillar walks out of its old skin. A new skin a few sizes bigger has already been formed. When the new skin is dry it continues to feed.
- Within 2 or 3 weeks the caterpillar can reach a weight that is a few thousand times its birth weight.
- Most caterpillars slough 4 or 5 times.

- At the last sloughing a caterpillar does not appear but **[what?]** a pupa. For this the caterpillar spins a silk pad onto the plant. It then hooks its back legs into this pad and hangs. Some make a girdle around their middle as well.

- Caterpillars are a great snack for many insectivores, so the caterpillar has a range of tricks.
- Some blend into the background of the plant they are on **[What is this is called?]**, others look like a twig.

