

Butterfly Basics

Classification

Scientists classify all organisms using a system that divides large groups of organisms into smaller groups of organisms based on physical and functional characteristics. The following illustrates the scientific naming of a Spicebush Swallowtail going from the largest grouping to the smallest grouping:

Kingdom:	Animalia
Phylum:	Arthropoda
Class:	Insecta
Order:	Lepidoptera
Family:	Papilionidae
Genus:	Papilio
Species:	<i>Papilio troilis</i>

All animals are placed in the kingdom Animalia. The Kingdom Animalia is subdivided into Phylums. Butterflies are in the phylum Arthropoda. All Arthropoda have the following characteristics:

- They are invertebrates (no backbone)
- They have an exoskeleton
- They have bodies that are divided into segments
- They have jointed legs

The phylum Arthropoda includes: crustaceans, spiders, centipedes, millipedes and insects. The phylum Arthropoda is subdivided further into classes. Included is the class Insecta. The common characteristics of the class Insecta are:

- They have an exoskeleton
- They have six legs
- They have three main body parts: head, thorax and abdomen
- They have one pair of antennae

- They have compound eyes as adults
- They develop through a process called metamorphosis

The next subdivision is Order. Butterflies are in the Order Lepidoptera. The word Lepidoptera is derived from two Greek words. "Lepidos" meaning scales and "Pteron" meaning wing.

The Order Lepidoptera is subdivided into families. Some of the most common families are papilionidae (Swallowtails), Nymphalidae (Brush-footed Butterflies), Lycaenidae (Gossamer Wings), Libytheidae (Snout Butterflies), Pieridae (Sulphurs and Whites).

Every organism has a species name that is created from the genus and a specific epithet or descriptive word. For example: *Papilio troilis* is the scientific name (species name) of the Spicebush Swallowtail. Scientific names are italicized or underlined. The genus is capitalized and the specific epithet is written in lowercase.

Most organisms also have a common name. The common name of *Papilio troilis* is the Spicebush Swallowtail. The problem with common names is that a single organism can have several different common names depending on where it is found.

Butterfly Anatomy

Butterfly bodies are divided into three regions: the head, thorax and abdomen. The important features on the head are the eyes, antennae and the proboscis. As an adult, butterflies have two large compound eyes. Each eye is made up of facets. Butterflies can see into the ultraviolet range of the light spectrum. Antennae are sensory organs that can be used for taste, smell, feel and navigation. The proboscis is a long slender tube. The butterfly uses its proboscis to sip nectar from plants. When not in use the proboscis is kept tightly coiled underneath the head.

The thorax contains the wings and legs. The wings are located on the thorax and are covered with millions of scales. The front pair of wings are called the forewings and the rear wings are called the hindwings. The scales create the colors on the wings. There are two types of coloration: pigment and structural. Scales that have pigments appear red, orange, black, yellow and earth tone colors. Structural coloration produces iridescent blues, greens, purples and silvers. Wing coloration has many different functions.

Temperature regulation is an important function. A butterfly's metabolism is dependent upon environmental conditions. If it is warm outside a butterfly will be more active, if it is cold it will be less active. Darkly colored wings help absorb heat and warm up the butterfly faster. Warning colors can provide protection against predators. This lets predators know that the butterfly is toxic. Butterfly wing coloration is also important in mate selection. Patterns are created that are recognizable to the opposite sex. Finally, butterflies that have full, mottled patterns use these colors to blend in with their surroundings.

Butterflies have 3 pairs of jointed legs that are attached to the thorax. At the end of the legs are tarsi (feet). Butterflies have sensory organs on their tarsi that are used to taste. This helps them select the right plant to lay their eggs on. Also the tarsi have tiny claws that help them cling to substrates.

Located on the sides of the thorax and abdomen are breathing holes called spiracles. Air enters through the spiracles and flows directly to the cells through an internal tube system called tracheoles. Butterflies do not have lungs.

Butterfly, Moth or Skipper?

Butterflies, moths and skippers all belong to the same Order Lepidoptera. There are several differences but the key-defining characteristic is the antennae. Some Lepidopterists consider skippers to be their own grouping, some lump them in with butterflies.

Butterflies	Moths	Skippers
Antennae clubbed	Antennae not clubbed	Antennae clubbed with hooked ends
Typically wings held closed when at rest	Typically wings held closed when at rest	Typically wings held open when at rest
Most are diurnal	Most are nocturnal	Most are diurnal
Most are brightly colored	Most are dull colored	Most are dull colored
Body slender and smooth	Body thick	Body thick and hairy

Key Ideas

- Butterflies are scientifically classified.
- Butterflies, moths and skippers form the Order Lepidoptera.
- Butterfly wings are covered with scales.
- Butterfly wings serve several purposes: Camouflage, warning to predators, temperature regulation and mate selection.
- The most important distinguishing characteristic between butterflies, moths and skippers are their antennae.

LIFE CYCLE BASICS

The Life Cycle of Butterflies

The word metamorphosis means, "to change form". Butterflies go through complete metamorphosis. This means that there are 4 distinct stages: egg, larva, pupa and adult. The duration of each one of these stages is dependent on the species of butterfly, the geographic location of the butterfly and time of the year. It can take a butterfly a couple of weeks or over a year to complete its life cycle. Generally, under ideal conditions the egg stage lasts from 3-6 days, the larval stage 2-4 weeks, the pupae 2 to 4 weeks and the adult 1- 4 weeks.

Egg Stage

The life cycle begins when the female lays an egg. Females seek out specific kinds of plants (host plants) that their larvae can feed on. They locate the correct plant by sight and smell. A female butterfly will often scratch the leaves of a plant that she has located by sight. Then by smelling the plant with sensory organs on her tarsi she can determine whether or not she has located the right hostplant for her young. If she detects the correct smell she will then lay an egg and attach it to the plant with a fast-drying glue-like chemical that she secretes. Some examples of butterflies and their host plants are: Monarchs lay their eggs on milkweeds; Spicebush Swallowtails lay on stinging nettle.

Butterfly eggs are about the size of a pinhead and vary in color and shape. Many butterflies will lay their eggs single but others will deposit them in clusters. For example the Monarch butterfly lays her eggs single but the Morning Cloak will lay her eggs in clusters. Most species of butterflies will lay hundreds of eggs, but there are a few exceptions that lay over a thousand in a lifetime.

Larval or Caterpillar Stage

The second stage of a butterfly's life is the larval or caterpillar stage. Once a caterpillar has hatched from its egg, it eats the eggshell and then begins eating the leaf it was laid on. Caterpillars are very picky about what they eat and will only feed on the correct host plant. If you are rearing caterpillars at home or in the classroom it is very important to know what kind of plant they eat. If a caterpillar is given the wrong kind food it will stop eating and starve to death.

As the caterpillar feeds it grows. This presents a problem to organisms that have an exoskeleton. So, in order for the caterpillar to get bigger it has to shed its exoskeleton. The shedding of the exoskeleton is called molting. As the caterpillar matures it molts or sheds its old, small skin. Each molt reveals a new, larger skin, which accommodates the growing caterpillar.

Anatomically speaking all caterpillars are similar. A caterpillar's head capsule is armed with chewing mouthparts, simple eyes and spinnerets, which produce silk. Most caterpillars have 13 body segments. From head to tail they bear three pairs of jointed walking legs, 4 pairs of prolegs and a pair of claspers. Spiracles on several body segments allow caterpillars to breath.

Pupa or Chrysalis Stage

The word chrysalis comes from the Greek word "cyrsos" meaning golden. Chrysalis can take on many forms. Some are leaf mimics, while others are covered with gold flecks.

This is where the transformation from a caterpillar to a butterfly takes place. Inside the chrysalis the caterpillar's tissues are broken down into a "cellular soup", reorganized and gradually rebuilt into the adult butterfly. Some butterflies pass the winter as a chrysalis while others are in this stage for only a few weeks.

Adult Stage

When the butterfly emerges from the chrysalis, it is unable to fly. It hangs upside down from the empty chrysalis shell or from a nearby branch or leaf. When it emerges its wings are wrinkled and damp. The butterfly has to pump blood from its swollen abdomen into its wings to inflate them. This can take up to an hour.

The butterfly also has to fuse its proboscis together. The proboscis of a newly emerged butterfly is separated into two halves. As the butterfly coils and uncoils the proboscis it zips them together forming the straw like feeding tube. Once the wings are inflated and hardened and the proboscis is zipped the butterfly will fly away in search of food and a mate.

Key Ideas

Butterflies have 4 life stages: egg, larva, pupa and adult. Butterflies require specific host plants on which to lay their eggs for their caterpillars to eat.

BUTTERFLY BEHAVIOR

Basking

The temperature of its environment dictates a butterfly's body temperature. When the environment is cool a butterfly is cool and its metabolism works at a slower rate. When it is warm the butterfly's metabolic rate is higher, creating sufficient energy for flight and other activities. One way to raise its body temperature is to bask. A butterfly that wants to bask will find a sunny and safe place to sit where it can spread open its wings and catch the sun's warming rays. In order to fly, a butterfly's body temperature must be between 82 and 100 degrees Fahrenheit.

Flight

Flying allows a butterfly to locate food and mates, escape predators, and in some cases migrate. Muscles in the thorax control the wings. These

muscles contract and relax to produce the wing-flapping movement. This in turn creates lift.

There are several different kinds of flight: darting, gliding, zigzagging, fluttering, etc. Different butterflies display different types of flight. A lepidopterist can use patterns of flight to help in the identification of a butterfly.

Roosting

Most butterflies are diurnal. So where do they go at night? At night they roost underneath the foliage of trees, plants, shrubs or grasses. Butterflies will even roost on overcast days, because they can't raise their body temperature high enough, without the help of the sun, to fly. Some butterflies, like the Zebra Longwing, roost in-group, while others roost singly.

A butterfly that is roosting will hang upside down with its wings closed. This position allows it to display the usually full colored underside of its wings. Displaying the full colored underside of wings helps camouflage it from predators.

Feeding

A butterfly spends most of its time searching for food. Once it locates a food source it extends its proboscis and probes for nectar. Nectar is the most common food source for butterflies but some also feed from the juices of overripe fruit, carrion, manure and tree sap in addition to nectar.

Puddling

You will frequently observe butterflies clustered around a puddle, a muddy spot or near a stream. This is referred to as puddling. Males most commonly display puddling behavior. Scientists believe that puddling provides important nutrients like salts and minerals that the butterflies can't get from nectar alone. Swallowtails, blues and sulphurs commonly puddle.

Courtship and Mating

Typically the male will seek out the female. To find females the males will engage in two basic types of mate-seeking behavior: perching and searching. Some males will pick a high spot in their environment and watch for passing females. If an object of the correct size, shape and coloration of a female passes by the male will leave his perch and investigate. If it is a female and she is receptive courtship will begin. If the male finds an unreceptive female, male, or a butterfly of another species, he will return to his perch.

Other males will display searching or patrolling behavior. Males will fly a route and possibly release pheromones that attract females. If the male encounters a receptive female along his patrol (route) courtship will begin.

Every species of butterfly has a unique courtship ritual. Butterflies mate on the ground or in the air. The actual mating act can last from 20 minutes to several hours. Some butterflies mate only once, some will mate several times. During mating the male passes a spermatophore, a "package" of sperm and protein, to the female.

Key Ideas

- A butterfly's metabolism is dependent upon the environmental temperature. They are "cold blooded".
- Butterflies bask in the sun to raise their body temperatures.
- Flight allows butterflies to locate food, mates and host plants.
- Flight allows butterflies to escape predators.
- Butterflies roost at night.
- Butterflies display puddling behavior to obtain salts and minerals.
- Butterflies feed on a variety of liquids, including nectar and the juices from overripe fruit, carrion and manure.
- The courtship behavior of butterflies is unique to each species.

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