Butterfly Basics

Why are butterflies so important?

Butterflies have an air of mystery about them and spark our imagination with their seemingly miraculous metamorphoses. These delicate, graceful creatures have much more than an aesthetic value. They are a valuable natural resource on earth and have an essential ecological role in maintaining earth's balance. From a human perspective, without the services of pollinators like butterflies and bees, we would not be able to raise the food crops that provide food for our tables. (Pollinators are critical to 90% of the world's flowering plants and thus are responsible for three quarters of the world's food crops.) Research indicates that some of our endangered native plants may be exclusively pollinated by butterflies and could be lost without them. As prey for many animals, butterflies are an important link in the food chain that ultimately feeds us. Caterpillars with their voracious appetites act as natural balancing agents for many plant species. Not surprisingly, these delicate creatures are environmental quality indicators and have come to symbolize a clean, healthy environment.

Butterflies are part of a large group of insects in the order Lepidoptera. By most counts there seems to be about 20,000 identified species of butterflies in the world, with the largest number of species found in tropical forests. The biggest threat to these creatures is habitat destruction and the most alarming loss of habitat is occurring in tropical regions, with rainforest being destroyed at the rate of one football field per minute. As forests disappear, so do the plants and animal species inhabiting them.

Efforts are being made to conserve butterflies. Some countries have passed laws to protect butterflies and their habitats, including the United States with the Endangered Species Act which lists butterflies on its "threatened" or "endangered" lists. Some tropical countries are finding viable alternatives for providing income for the people through sustainable management of their natural resources. This change of mindset is critical to saving butterflies. Butterfly farming has become a popular industry in the tropics because they provide jobs for local people and promote conservation of the natural resources. Unlike traditional farming methods in tropical countries where native plants are cleared to grow crops that produce a quick cash return, butterfly farmers are absolutely dependent on the native plants for their butterflies, and so work to protect the native vegetation. All butterflies sold commercially are bred in captivity, not captured from the forests, so not to diminish the population.

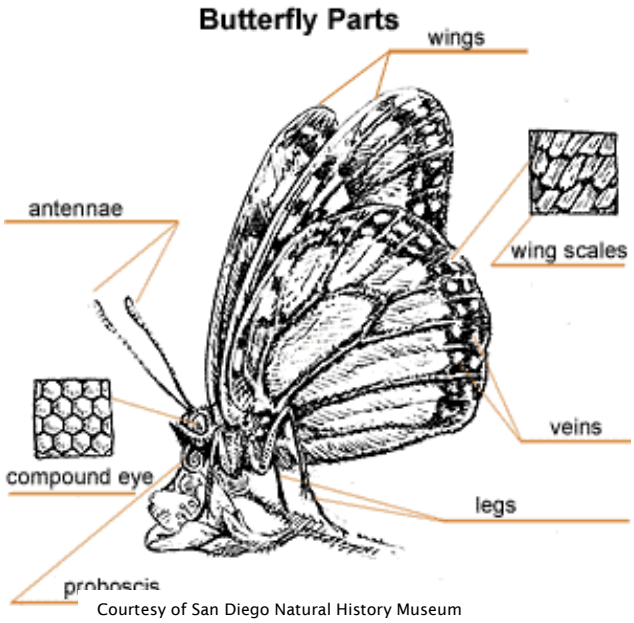
What is a butterfly?

A butterfly is an **insect.** It is a member of the order **Lepidoptera**, a huge group of about 180,000 species of butterflies and moths. The scientific name Lepidoptera comes from two Greek words: "lepidos" meaning 'scale' and "pteron" meaning 'wing'. These scaled wings are what make butterflies different from other insects. As a matter of fact, butterflies are covered by thousands of tiny scales all over their bodies, from their feet to their wings. These scales make the beautiful colors and patterns that cover their wings. There are pigment colors and/or structural colors in the scales.

Physiology of a Butterfly

Form and function

In its adult stage, the butterfly has all the parts of an insect: a head, a thorax, and an abdomen. It also has six legs like other insects and two sets of wings. The butterfly's ***head*** is equipped with two powerful sensory organs, ***antennae***, which are used to smell, taste, feel and navigate. A butterfly's compound eyes are made up of many flat lenses called ***facets***. Butterflies see all the colors we see and more. They are able to see the ultraviolet range as well, and need bright light to see color. Another feature of the butterfly is its special feeding tube, or ***proboscis***, which it keeps coiled until it is needed to obtain food.



Courtesy of San Diego Natural History Museum

The ***thorax*** supports its wings and legs with powerful connecting muscles. A butterfly has a segmented body with two pairs of wings, front ***forewings*** and rear ***hindwings.*** It has a pair of legs attached to each segment in its thorax. You will notice some butterflies, "brushfoot", have highly reduced front legs (like little brushes) that are useful in tasting and smelling. Typically, the two larger sets of legs are used for landing and walking. Many butterflies have special cells that act as chemical receptors on the bottoms of their feet that help them taste the leaves that they land on in order to identify the plant. Tiny claws on their feet help them walk and climb.

The ***abdomen*** contains the butterfly's digestive, circulatory and reproductive systems. Like other insects, butterflies lay eggs to reproduce. In the last two or three segments of the abdomen are the genitalia used in the reproductive process. Along the side of the thorax and abdomen lie tiny openings called ***spiracles.*** Since butterflies don't have lungs, spiracles act as ventilation holes allowing oxygen to flow directly into the cells. Butterflies have a simple circulatory system with a pump (heart) attached directly to a long tube that extends through the body containing the hemolymph (insect "blood") which carries nutrients & waste.

Male and female butterflies can sometimes be distinguished by certain features on the wings, but often the differences between the sexes are subtle.

Is it a Butterfly or a Moth?

It's often confusing when trying to tell the difference between butterflies and moths, because they differ along a range of characteristics. There are similarities and differences. Both are insects and members of the order Lepidoptera. They have all the same body parts and are considered scaly-winged insects. But they can vary by the shape of their antennae. Butterflies have clubbed antennae, moths have feather-type antennae, and skippers have hooked antennae. Most butterflies are ***diurnal*** (active during the day) and many moths are ***nocturnal*** (fly at night).

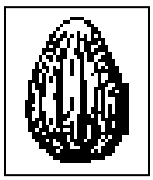
Life Cycle of a Butterfly

Metamorphosis

The word "metamorphosis" literally means "changing form". Some insects, including Lepidoptera, undergo what is termed a complete metamorphosis, meaning they completely change form from one stage to another. There are four distinct stages in butterflies:

- egg - embryonic stage
- larva (caterpillar)- the growing and feeding stage
- pupa (chrysalis)- when metamorphosis turns the larva into an adult
- adult (butterfly)- flight and reproductive stage

The average life span of a butterfly through all four stages is about three months. Most adults live about three to four weeks.



The Egg

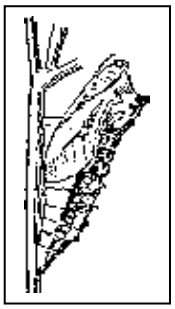
After the female butterfly has mated, it searches for a specific kind of plant (**host** plant) on which to lay her eggs. There is a reason for this; the plant will be used by the caterpillar for food. The female lays her tiny eggs either singly or in clusters on the plant, according to its kind. Eggs are attached to the plant by means of an adhesive excreted by the female. This process of egg laying is called **oviposition**. Most butterflies lay hundreds of eggs, but only about 2% actually survive to become an adult. The tiny eggs are about the size of a pin-head and are encased in a shell called the **chorion**. Among species of butterflies, eggs vary in shape and surface texture. The average time for incubation of a temperate egg is usually 4-10 days. However, some species hibernate in the egg stage, so incubation time could be 6 to 7 months.

The Caterpillar

The second stage begins when the caterpillar eats its way out of the chorion in a process called ***eclosion***. This emerging larva is an eating machine- hard mandibles for chewing on its tough ead capsule attached to a long, soft body housing a long digestive tract. The organism is designed to feed, digest its food, and grow. Its first meal is its own shell, but then it begins to consume the plant on which it hatched. Caterpillars are picky about what they eat, consuming only a certain kind of vegetation. These are their host plants and are usually native plants. An example is the monarch caterpillar that will only eat the milkweed plant. If they fall or are removed from their host plant, they will refuse to eat and can starve to death rather than consume the wrong plant. This is important to remember if you plan to raise butterflies.

The body of a caterpillar is made up of 13 segments with three pairs of ***true*** legs on the thoracic segments, four pairs of ***prolegs*** on the abdomen, and one pair of prolegs at the rear of the abdomen. True legs are segmented like all other insects. Prolegs are like "sucker-feet" and are used in walking and holding on. Along the abdomen of caterpillars are tiny holes, called ***spiracles***, which allow for respiration.

As a caterpillar grows, is must shed its skin, or ***cuticle***. This process is called "molting" and is the process of shedding the old, smaller skin for a newer, roomier skin. Most species molt four times during the larval stage. When the larva, as a prepupa, is ready to begin pupation, it stops eating and begins to wander around. Generally, the life span of a caterpillar is 3 to 4 weeks, depending on the species. As always, there are exceptions, because some butterflies overwinter as caterpillars and live many months.



The Chrysalis

The larvae of butterflies do not spin a cocoon (a cocoon is the case which encloses a moth). The butterfly pupa is naked, or not encased. When the caterpillar sheds its last skin, its inner skin hardens and forms the chrysalis. The caterpillar attaches itself to a twig or other surface by silken threads. Inside the chrysalis, the body of the adult butterfly continues to form and when the transformation is complete, the butterfly makes its way out of the chrysalis. The average time for a chrysalis stage is 7-14 days, although some overwinter or hibernate in this stage and have a life span of about 6-7 months. Moths construct a cocoon of silk, soil, or plant material. The cocoon provides protection and camouflage for the pupa inside.

In a process known as ***eclosion***, the fully grown butterfly emerges from its chrysalis. At first, it hangs upside down and is unable to fly because its wings are limp and wrinkled. It pumps blood from its abdomen into its wings, inflating them to full size, then excess fluid drains out. In about thirty minutes, the wings are full sized and hardened and the butterfly begins its adult mission. This stage of the butterfly's life is dedicated to finding food and locating a mate. In her short time as an adult, the female butterfly mates, locates a host plant and deposits her eggs on the plant. Normal life span in this stage is from three to four weeks.

References: *Everything You Ever Wanted to Know About Butterflies,*
Discover Butterflies, Callaway Gardens

Strategies for Survival

Threats to Butterflies

Butterflies have a hard struggle for survival. Only about two percent of their eggs survive until the adult stage. The greatest threats throughout all stages are natural biological agents such as microbes (bacteria, viruses, fungi), parasites (wasps, flies) and parasitoids (wasps and flies). Other threats come from predators and by human impact on the habitat.

Bacteria present in unclean containers can cause the death of larvae. Viral pathogens can kill a larva and quickly spread to other individuals, while fungal pathogens can kill butterflies at each stage, from egg to adult. A ***parasite*** weakens but does not kill its host because its own life depends on the survival of the host- true parasites have rarely been reported on butterflies. ***Parasitiods*** are a greater problem. These lay their eggs on a host and their larvae devour the tissues of the host, eventually killing it. These parasitoids account for the need of a USDA permit as they may infect native butterflies.

Predators kill butterflies during all stages of the life cycle. Butterflies have both invertebrate and vertebrate predators. The invertebrates include spiders, mantids, ants, and wasps. Vertebrate predators include frogs, lizards, birds and mammals.

In addition to natural agents, man creates a number of threats through the use of insecticides and herbicides around a butterfly's habitat. Grass mowing and other forms of habitat destruction disrupt breeding habitats for butterflies.

Butterfly Defenses

Butterflies use a variety of complex defenses which involve appearance, physical characteristics, behavior, and chemistry.

Chemical Defenses

The most common defense system for butterflies involves "chemical warfare". Noxious chemicals can be found in all stages of the butterfly's life cycle in some species. Toxins can be found in eggs of butterflies that consumed toxic plants as a caterpillar. Some larvae bear neck glands that give off a offensive odor when threatened by attack, while others contain toxic chemicals in their bodies. The toxins in the bodies and wings of adults that are obtained during their larval feeding stage as they feed on a toxic host plant (Monarchs feeding on milkweed). Predators learn by trial and error which butterfly species will be distasteful.

Appearance

Butterflies use appearance to avoid being preyed upon through two interesting adaptations: mimicry and protective resemblance.

Mimicry implies that one species of organisms closely resembles another species that is avoided by predators. Thus, a species gains protection from predators by appearing to be distasteful. They do this by advertising a conspicuous color pattern, such as red or orange and black. Potential predators learn by trial and error these signals and then avoid the distasteful species. For example, the monarch contains chemicals in its body that make them unpalatable to most predators because they feed on milkweed, which contains chemical toxins. Predators learn to recognize the distinctive color patterns in monarch wings and avoid them. Viceroy butterflies take advantage of the situation and model monarch coloration and are left alone by potential predators.

Protective Resemblance

This is a more passive adaptation that occurs when an organism resembles its environmental surroundings and gains protection from predators by being overlooked. Larvae often use camouflage to blend into the background. Some swallowtails look like bird droppings as they rest on upper surfaces of leaves. Some roll themselves in bits of dead leaf matter or roll leaves into a tube and rest inside. In adult butterflies, some look dead leaves on a branch or the underside of their wings, which are exposed when they are resting, may have patterns that confuse predators. Eye-spots cause the deflection of an attack by directing predators to a false-head, thus allowing the butterfly to escape with only a damaged wing. Other eye-spots resemble owls or other large predators. Hairstreak butterflies have hindwing filaments which resemble antennae.

Physical Characteristics

Butterflies use physical armaments as a means of defense. The most obvious defense strategy is the spines of caterpillars or chrysalis which may act as a barrier to attack of parasitoids, ants, birds and monkeys.

Mutual Relationships

Why do butterflies need plants?

As mentioned before, plants are essential to butterflies during each stage of the butterfly life cycle. After mating, the female butterfly must find just the right "host"

plant on which to lay her eggs. For example, among our native butterflies, the monarch will only lay eggs on milkweed; black swallowtails on parsley, dill and wild carrot; painted ladies on thistles and hollyhock. When the larvae emerge, they immediately begin to eat the vegetation of the host plant. Caterpillars are selective about what they eat and will starve rather than eat the wrong plant.

Why do plants need butterflies?

Even though butterflies and moth larvae are considered "plant pests" because of the damage to vegetation, the truth is that plants could not survive without the services of butterflies and other pollinators. It is believed that some native plant species are only pollinated by butterflies, so their reproduction depends on these winged creatures.

Butterflies are attracted to plants by their colorful petals and by the lure of sweet smells. While feeding from the nectar and/or pollen, butterflies unknowingly provide the service of transferring pollen from the stamen of one plant to the stigma of another. Pollen collects on the bodies of butterflies and is dropped off on the next plant it visits, thus providing the necessary material for the plant's reproduction.

Conservation and Ecology

Butterflies have an important ***ecological niche*** in our environment. As pollinators, they are responsible for maintaining plant species. Not surprisingly, they are environmental quality indicators, sensitive to pollution in many forms in our surroundings.

Each kind of butterfly requires a certain kind of habitat. Some find their habitats in forests, grasslands, and even back yards and school grounds. The most essential components of a habitat are plenty of sunshine and the right kinds of plants (host plants and food plants).

The largest number of species of butterflies is found in tropical rain forests. The biggest threat to these creatures is habitat destruction and the most alarming loss of habitat is occurring in tropical regions, with forests being destroyed at the rate of one football field per minute. As these forests disappear, so do the plants and animal species that inhabit them. Conservation means the care or protection of natural resources. Conservation is critical to saving butterflies from extinction.

The best way for us to be involved in conservation is to provide habitats for butterflies that are native to Texas or that are passing through on their way to other places, like tropical forests in Central and South America. While we may not be able to do anything about the destruction of habitats elsewhere in the world, by providing a habitat in our back yard or on our school grounds, we will be doing our part ensure that the butterflies that pass through Texas have a chance of reaching their destinations.

We also can learn more about the plants, animals and insects in our area so that we can provide habitats that are equipped to meet the needs of all wildlife. People make careers studying plants and animals. Scientists who study plants are ***botanists***. Those that study insects are ***entomologists***, and those that specifically study butterflies and moths are called ***lepidopterists***. Scientists who study the relationships of plants and animals in our environment are called ***ecologists***.

Butterfly Behavior

(Adapted from Discover Butterflies, Callaway Gardens)

Butterflies exhibit rather curious behavior during their short life spans as adults. You have probably noticed some of these but may not have understood what you were seeing.

BASKING

When you see butterflies perching on a rock or a branch, spreading their wings flat to the incoming sun, they are absorbing the sun's rays in order to warm their muscles. Butterflies are cold-blooded creatures and must warm up in order for their metabolism to speed up and furnish them with energy for flying.

PUDDLING

Butterfly puddling is a social behavior in which male butterflies congregate in "puddle clubs". If you see butterflies clustered around a mud puddle or a muddy stream bank, you will notice that they are probing the mud with their proboscises to extract water and minerals from the ground. Since most puddlers are male butterflies, scientists believe that salt helps them produce pheromones (chemical substances) that help them attract a mate. Monarchs and queens get minerals from the heliotrope plant.

ROOSTING

Butterflies are ***diurnal***, meaning they are active during the day and sleep at night. Butterflies find a safe place in the foliage of trees, shrubs or grasses to ***roost.*** The roosting butterfly folds its wings together and hangs upside down. Since the underside of a butterfly's wings is usually dull-colored, this position helps camouflage it from predators. Watch for longwings roosting on aerial roots.

FLYING

Have you ever watched birds fly through the air? If so, you know that each kind of bird flies in its own distinctive way. So do butterflies. Different kinds of butterflies fly at different speeds and with different styles. Some flutter, some dart, some glide and some zigzag. The way they fly also has something to do with whether they are trying to locate food or a mate, or if they are trying to escape from a predator. People who study butterflies learn their flight patterns so they can easily recognize and identify them.

FEEDING

A butterfly spends most of its time searching for food, going from flower to flower in search of nectar. It needs quite a bit of the sweet, high-energy liquid because of the tremendous amount of energy it spends each day in flight. A butterfly will land on a flower; uncurl its proboscis and suck the nectar from the flower. Some butterflies also feed on overripe fruit, carrion, manure and tree sap. You will see fruit feeders in the conservatory.

COURTING

People and animals usually become interested in finding a mate and having children. At that point, a person begins to "court" another person to find just the right mate. Butterflies have their own special ways of courting. Circling, spinning, spiraling, and fluttering flights are all part of their courtship rituals. Butterflies in search of a mate are attracted by color patterns on the wings and by pheromones, or chemical scents that cause attraction. Male butterflies often engage in "perching" and "searching" mate-seeking behavior. Males pick a strategic perching site where they can observe passing butterflies, and if they see a likely candidate, they fly out to check it out. If the passerby is receptive, the courting ritual begins. Other males search or patrol an area by flying back and forth in a slow, gliding fashion. When just the individual is found, the male and female butterflies mate. After mating, the female butterfly must find the right host plant on which to lay her eggs. The life cycle begins again.

What's the best way to observe the butterflies?*

- Butterflies are active creatures, so it's best to observe them when they are feeding or drinking. Stand within sight of a group of nectar-bearing flowers and wait for a butterfly to visit. Patience is the key!
- Most species of butterflies are most active between the hours of 10am and 4pm. After 4pm, they tend to roost to rest.
- Rapid movements and loud noises will scare the butterflies away. Move as slowly and quietly as possible. You might be lucky and have one land on you! Don't touch them.
- Remember, butterflies have compound eyes and are extremely sensitive to the slightest movement.
- Butterflies are cold-blooded organisms. Their body temperatures generally must reach 62 to 75 degrees Fahrenheit before they can become active. The Conservatory maintains a tropical environment, so therefore it will be quite warm and humid, the perfect climate for butterflies. Butterflies also love sun, so if it is a cloudy day, the butterflies may be roosting among the trees and shrubs.
- Butterflies are delicate. Please do not touch!

*Adapted from Callaway Garden's "Discover Butterflies"

Butterfly "Believe it or Not"
Commonly Asked Questions about butterflies

1. *What is the largest butterfly in the world?*
   Birding butterflies from tropical Australia, Southeast Asia and tropical Africa can have a wingspan of from five to eleven inches, almost a foot!

2. *What is the difference in a butterfly and a moth?*
   They are both members of the Lepidoptera order of scaly winged insects. The most obvious distinction of the two can be observed by looking at their antennae. Butterfly antennas are shaped "like a golf club" with a long, slender shaft and a club at the end. Moths have feather-like or simple straight antennae, with no club at the end. Also, butterflies generally fly during the day and moths at night, which explains another feature: most butterflies are bright colored while moths tend to be duller colored.

3. *How many kinds of butterflies are there?*
   There are approximately 20,000 species of butterflies in the world, with 725 species occurring in North America north of Mexico, 2000 in Mexico and 490 in Texas.

4. *Where in the world are the most species?*
   More species are found in the tropical rainforests, with Brazil having the greatest diversity of species.

5. *Where are the fewest species of butterflies?*
   There are none in Antarctica and only a few in Iceland and Greenland. Surprisingly, Hawaii has only about 15 species.

6. *Are there any endangered or threatened species in North America?*
   The US lists 16 species as endangered or threatened, one was thought to have become extinct.

7. *What do you call people who study butterflies?*
   Scientists who study butterflies are called Lepidopterists (because of the scientific name of the order Lepidoptera). Entomologists study insects in general.

8. *What does the name Lepidoptera mean?*
   The name comes from the Greek words 'Lepidus' meaning scaled and 'Petron' meaning wing, thus scaled winged insect.

9. *What is the origin of the common name 'butterfly'?*
   It is thought to come from long ago when bright yellow butterflies flying throughout England in the early spring reminded people of the color of yellow butter. Some believe that the name "butter-colored fly" was shortened to "butterfly". Another legend states that the name "fluttery" was given to them referring to their graceful flight, and that the name was later reversed to butterfly.

10. *How long do butterflies live?*
    Depending on the species, the average life span of an adult butterfly is between 2-3 weeks. Some live for only 2-3 days, and some for 7-8 months. A few in the American tropics live up to one year. The butterflies in the conservatory will live longer than expected because there are no natural predators.

11. *Do some butterflies only have four legs?*
    All butterflies have six legs, like other insects. Nymphalid butterflies appear to have only two pairs (4) legs because the front legs are sometimes greatly reduced and not visible, but still are useful for tasting and smelling.

12. *Do caterpillars have the same number of legs as butterflies?*
    No, caterpillars have three pairs (6) of true legs, four pairs (8) of prolegs in the middle of the abdomen, and one pair (2) of prolegs at the posterior of the abdomen. True legs are segmented with claws and prolegs are more like suctions.

13. *Do butterflies have brains?*
    Not really. Butterflies, like other insects, have nerve bundles in their heads attached to a nerve cord that runs throughout their bodies. Most butterfly behavior is genetically programmed through DNA. However, some can learn simple behaviors such as finding a favorite roosting place or nectar source. Longwings "trapline" to their favorite nectar flowers.

14. *Can butterflies hear?*
    Not the way we do. The tympanic membrane, or sound sensitive organ in our ears, is poorly developed or absent in butterflies. However, butterflies are sensitive to aerial vibrations made by sound waves. These are registered by sensory organs on their antennae and body surfaces.

15. *Can butterflies make sounds?*
    Generally, butterflies don't make audible noises, but there are exceptions. Butterflies called "crackers", found in the tropics and in the lower Rio Grande Valley of Texas, can produce a clicking sound when the butterfly claps its wings.

16. *Can butterflies smell?*
    Yes. Butterflies have a great sense of smell which it uses to locate food, mates, and avoid predators. The sensory structures for olfaction (or smell) are located in the antennae.

17. *Can butterflies taste with their feet?*
    Yes. All six feet of butterflies are equipped with sensory receptors for detecting taste. This is very important for females who are in search of just the right host plant for laying her eggs.

18. *How do butterflies breathe?*
    They have no lungs, but they have a tracheal system consisting of tubes and opening to the outside of the body called spiracles. Oxygen passes through the spiracles and goes directly to the tissues.

19. *Do butterflies sleep?*
    Yes, butterflies shut down their metabolic process to rest during the night. They are diurnal, active during the day and sleep at night. To rest, butterflies cling to the underside of vegetation, grasses or a man-made structure and hang upside down. This is called roosting.

20. *Where do butterflies go during the winter?*
    In areas where temperatures drop below freezing, butterflies spend their time in one stage of their life cycle that is resistant to freezing, either as caterpillars, pupae or eggs. A few species spend the winter as adults, hibernating in holes in trees or other crevices.

21. *Do butterflies drink water?*
    They usually get enough water from their nectar diets and do not need extra water. The monarch drinks water to avoid dehydration. When butterflies are observed "puddling", they are usually extracting minerals from the soil and will excrete the excess water.

22. *Do male and female butterflies differ in color?*
    Yes, in many species male butterflies are brighter in color than females. Scientists theorize that this is a strategy that facilitates mate recognition allowing butterflies to spot one another from a distance.

23. *Do male and female butterflies differ in size?*
    As with other insects, female butterflies are larger than males. Females bear the eggs and must store significant quantities of fat for a lengthy metabolism in order to complete the task of oviposition. Females also live longer. Males usually live only a brief time after mating.

24. *How many eggs does a butterfly lay?*
    On average, a female lays 100-400 eggs, but some lay many more. High risk species lay greater numbers of eggs than those with lower risks. Only about 2% of eggs develop to a mature butterfly. Some lay their eggs singly over a period of time, and some lay them in clusters.

25. *How high can butterflies fly?*
    Most butterflies do not fly very high since they spend most of their time feeding or laying eggs. Migratory species, like the monarch, often take advantage of wind current and thermals and ascend to considerable heights. They have been observed at over 7,000 feet off the ground!

26. *How fast do butterflies fly?*
    Some butterflies have heavily muscled bodies and are capable of extremely rapid bursts of flight. Again, migrating species, using prevailing winds to supplement their own flight, have been clocked at over 50 miles per hour for extended periods.

27. *Do American butterflies migrate?*
    Only the Monarch has a true migration that is leaving one location flying to another and then returning to their origin. Other species travel long distances but never return to their original location.

28. *Why does the monarch migrate?*
    Monarchs migrate to escape subfreezing weather. It is tropical in nature but has over time located in colder climates. No stage of its life cycle can survive freezing temperatures, so it is forced to move to warmer climates and then return to where they came from to reproduce in the spring.

29. *How does the monarch navigate?*
    The sun's position in the autumn sky prompts the monarch to migrate. Ultraviolet (UV) receptors in the butterflies eyes help orient it to direction. This navigation system is

connected to a biological clock in its brain and the two systems guide the butterfly to its preprogrammed winter destination.

30. *What is the best time of day to observe butterflies?*
    Most butterflies are diurnal and fly during daylight hours. Since butterflies rely mainly on the sun to warm their bodies, most are not active until mid morning. In our part of the country, generally between the hours of 10 AM and 4 PM butterflies are most active. Cloudy days also affect peak times for activity. Some species in the tropics are **crepuscular**, that is they are active at dusk and dawn.

    Information from EVERYTHING YOU EVER WANTED TO KNOW ABOUT BUTTERFLIES, by Gary Noel Ross, PhD. and the North American Butterfly web page.

About the butterflies…

The butterflies in the exhibit are from several places around the world. These butterflies have not been captured from the wild but were raised on butterfly farms under a captive breeding program and sent to us in the pupa state. A lot of the butterflies are from Ecuador, and some were raised in Florida in a breeding program. Butterfly farming (or breeding) does not impact the local environment the way other types of commercial farming does. Instead, farmers are encouraged to protect and nurture the native plants because the plants are essential for raising butterflies. The income from the sale of the pupa provides much needed income for the people of underdeveloped countries.

Although our butterflies are tropical, some of the species migrate through Texas, especially South Texas regions. The Monarch actually breeds in Tarrant County and the Julia has been known to migrate as far north as North Texas. But most are exotic species imported from a foreign country. Because of the possible damage the exotic species can do to our local environment, the U.S. Department of Agriculture considers them potential pests. That is why so many precautions have to be taken to keep them from escaping the Conservatory. The butterflies arrive in their pupa stage and are carefully inspected for diseases that might contaminate the others. After they emerge from their chrysalis, they are released into the conservatory. The life expectancy for butterflies in the adult stage is only about two weeks, but the butterflies are allowed to live out their lives in the closed conservatory after the exhibit is over. According the USDA regulations, the butterfly remains handles as biowaste. Therefore, collecting butterflies is not allowed.

Please help us watch for potential escapees by checking for stowaways as you exit the Conservatory.

Most butterflies are host specific, which means they depend on a specific plant or groups of plants for the survival of their offspring. Female butterflies will only lay their eggs on a plant that will provide food for the larvae as they emerge. Caterpillars will only eat certain plants and will starve if they don't find the right ones. These plants may be available outside the Conservatory (hence the USDA's concerns). Because of the limited time frame of this exhibit, reproduction of the butterflies cannot be permitted. Therefore, none of the plants in the conservatory act as host plants for the butterfly species. But these butterflies will need nectar-producing plants to provide them with food. The plants in the conservatory and those brought in will serve this purpose. Butterflies also love rotting fruit that provides a rich sugar source, so fruit will be brought in to feed them.

Online Resources

A great online experience for seeing the butterfly lifecycle over time- http://www.livemonarch.com/adopt.htm. You "adopt" an egg, name it and receive personalized email with photos of the growing butterfly.

Great suggestions for extending the learning in the classroom are on pre-/post activities for schools: North American Pollinators Protection Campaign. http://www.nappc.org

To learn about the Dallas County Lepidopterists' Society and year-round local activities for the butterfly hobbyist, go to www.dallasbutterflies.com

Resources

Brock, Jim and Kaufman, Kenn. Butterflies of North America ISBN 0-618-15312-8

Callaway Gardens. Discover Butterflies!, Pine Mountain GA, 1991.

DeVries, Philip J. The Butterflies of Costa Rica and their Natural History, Princeton University Press, New Jersey, 1987.

Eid, Alain and Viard, Michel. Butterflies and Moths of the World. Chartwell Books, New Jersey, 1997.

Feltwell, John. Eyewitness Explorers: Butterflies and Moths , Dorling Kindersley Publishing, London, 1993.

Kalman, Bobbie & Everts, Tammy. Butterflies and Moths, Crabtree Publishing Company, New York, 1994.

Midwest Public Garden Collaborative, "Partners for Growing Science Series"

Neck, Raymond. A Field Guide to Butterflies of Texas, Texas Monthly, Gulf Publishing Company, Houston, 1996.

North American Butterfly Association. Butterflies of North Central Texas.

Proctor, Michael. Yeo, Peter and Lack, Andrew. The Natural History of Pollination, Timber Press, Inc., Oregon, 1996.

Ross, Gary Noel, PhD. Everything You ever Wanted to Know about Butterflies, Gary Noel Ross, Louisiana, 1995.

Stokes, Donald & Lillian. The Butterfly Book. ISBN 0-316-81780-5.

Literature Suggestions (books available in the BRIT Burk Library)

A Hummingbird's Life by John Himmelman.

Butterfly House by Eve Bunting

Butterflies and Moths by Bobbie Kalman and Tammy Everts.

Eyewitness Explorers: Butterflies and Moths by John Feltwell, Dorling Kindersley Publishing.

Honeybee's Busy Day by Richard Fowler. A summer day in the life of a honeybee as it gathers nectar from various flowers.

Hurry and the Monarch by Antoine O. Flatharta. A tortoise in Wichita Falls learns about monarch migration and life cycle. Engaging and beautifully illustrated.

Monarch Magic! Lynn Rosenblatt. Imagine a beautiful monarch butterfly, weighing less than a dime and only a few weeks old, setting out on a journey of 2500 miles, with no map, no directions, and no leader. It's a wonder of nature… and you can share in it!

The Family Butterfly Book by Rick Mikula. Excellent classroom resource with activities, projects, and a field guide that shows all four stages of the life cycle for the most common butterflies.

The Life Cycles of Butterflies: From Egg to Maturity, a Visual Guide to 23 Common Garden Butterflies by Judy Burris and Wayne Richards. Each butterfly is shown from start to adult, with sequential photographs of the egg, caterpillar, chrysalis, and emerging butterfly. Additional detail shots highlight caterpillar behavior, changes in the chrysalis as the wing pattern emerges, open- and closed-wing shots, and the color variations between the male and female butterflies.

The Magic School Bus: Inside a Beehive by Joanna Cole and Bruce Degen.

The Moon of the Monarch Butterflies by Jean Craighead George.

*The Reason for a Flowe*r by Ruth Heller. Pollination and flowering plant reproduction.

Waiting for Wings by Lois Ehlert. Butterfly metamorphosis with special pages at the end for identifying butterflies and butterfly-attracting flowers.

Where Butterflies Grow by Joanne Ryder. What it feels like for a butterfly to journey through its life cycle with gorgeous illustrations.