



The Mystery of Butterflies

Objective:

1. Students will demonstrate knowledge regarding the physical and behavioral characteristics of the butterfly as it relates to biodiversity and the natural environment.
2. Students will understand sustainable farming and the relationship to butterfly farming.
3. Students will be able to compare and contrast butterflies and moths.

Performance Objectives:

Strand 3: Concept 1 – PO 5, Concept 2 – PO 5

Strand 4: Concept 3 – PO 1 – 3

NGSS: HS – LS 1; LS 2

CCSS: 9-10. W. 2; 11-12. W. 3

Background Information:

When you think of a butterfly, you probably think of a beautifully colored insect that flutters around the flowers in a garden. Butterflies are part of the insect world and have likely been on Earth from the time of the first flowering plants. Scientists believe that there are over 220,000 species of Lepidoptera and around 20,000 species are butterflies, which probably evolved from moths. Butterflies are found in all parts of the world, except in Antarctica. According to NABA (North American Butterflies Association), 725 species have been identified in North America with about 575 of those living in the lower 48 states of the United States.

Grades: 9-12

Related Literature:

Butterflies of North America

Jim P. Brock

Peterson's First Guide to Butterflies and Moths

Paul A. Opler

Butterfly Field Guide

Christina Richards

Hummingbirds and Butterflies

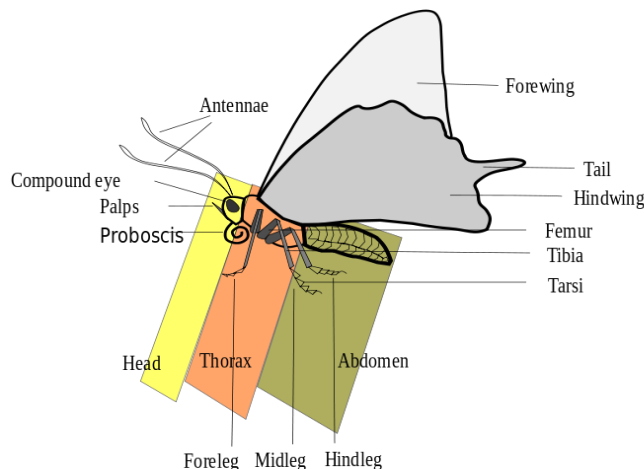
Bill Thompson III and

Connie Toops

Most butterflies stay near their place of origin rather than traveling long distances. Some butterflies, such as the monarch, go to great lengths to complete their seasonal migration. The monarch migration is the longest in the world and covers distances both north and south across the United States, into Canada and finally Mexico. As the seasonal migration takes place, monarch females deposit their eggs on milkweed plants along the way. The complete migration involves several generations of monarchs as each butterfly expands the population of migrating monarchs. Miraculously, the monarchs find their way from the milkweed fields of North America to the wintering sites in the mountains of Mexico some 2,500 miles away. The mystery remains as to how these beautiful creatures manage such a challenging journey.

Butterflies, such as the painted lady, the common buckeye, the dark blue tiger, the double banded crow and the purple crow take part in seasonal or weather-related migration in areas of the United States, Europe, India and Asia. The migration pattern for these species is somewhat different from that of the monarch. Butterflies and moths that live in tropical regions of the world have the advantage of moderate climates most of the year, which means that many of them can remain in their place of origin for the duration of their life. Butterflies and moths can be vulnerable to climate changes and severe weather patterns that disrupt the ecosystem and interrupt their natural migration patterns.

With signature characteristics of insects, butterflies have bodies that are divided into three main parts: the head, thorax and abdomen. In addition, butterflies have six legs, a set of antennae, a **proboscis** and two pairs of wings. Like other insects, butterflies have an exoskeleton that protects their body and is made of a substance called “chitin.”



The **Proboscis** is a tubular mouthpart that stays coiled up while the butterfly is in flight or at rest.

Butterflies are cold-blooded, which means they rely on the heat that is in the environment around them. Often, on cool days, butterflies will bask in the sun to warm their bodies before taking flight.

(Diagram by L. Shyamal)

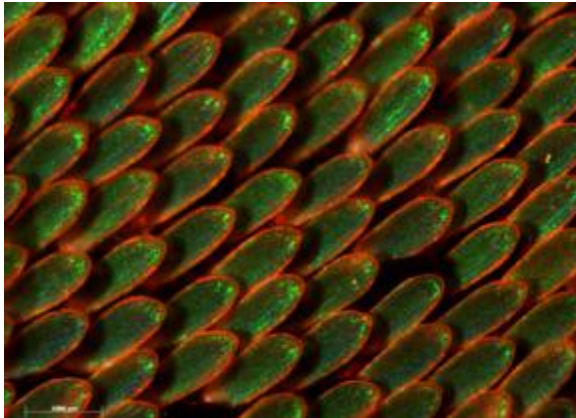
Butterflies and moths do not have mouth parts. The proboscis is used to consume nectar, water and other sources of food. When sipping nectar, the proboscis is extended outward like a straw into the flower. When the butterfly is at rest, the proboscis is coiled up under the head.

The antennae are used for balance in flight and as a sensory receptor. Butterfly antennae have a distinctive “club” at the end. A moth has antennae that are either thin and straight or feathery in appearance.

Butterflies and moths have compound eyes that are large and comprised of thousands of hexagonal shaped **ommatidia** (tiny sensors). This allows the butterfly to see in all directions at once. Butterflies and moths are sensitive to movement and can distinguish day from night.

The thorax, middle of the body, connects the legs and wings to the body. The abdomen includes the reproductive, circulatory, digestive and respiratory systems. Liquids are the only substances entering and exiting the butterfly’s body. The **spiracles**, small openings along each side of the abdomen, allow oxygen to enter the body and carbon dioxide to exit.

Both butterflies and moths have wings that are made of thousands of tiny scales. Each scale is one color, but put together, the wings of the butterfly and moth often reflect the brilliance of deep illuminating color.



Notice how the wing scales on this Amazonian Butterfly are closely aligned in a pattern that becomes the signature marking of the specific species. The tiny scales are unique to Lepidoptera and distinguish them from other insects. Wing scales are so delicate that once they are rubbed off, they cannot grow back. That is why it is important not to handle the butterfly or moth wings.

(Photo by Richard Prum)

Butterflies generally fold their wings vertically up over their backs when at rest. Moths rest with their wings open or folded downward over their body.

The **life cycle** of the butterfly involves 4 stages: egg, larva, pupa and adult. Like many other insects, the butterfly goes through a complete metamorphosis as it

develops into an adult. Moths, bees, wasps and ants are a few of the other insects that go through a complete metamorphosis.

Depending on the species, butterflies can lay many hundreds of eggs during their life. Generally, the female butterfly lays her eggs on the underside of leaves or even twigs. If the outside temperature is right, the eggs will hatch in about one to three weeks and the newly emerged caterpillar will begin the second stage of the life cycle. The tiny caterpillars start their life with a huge appetite and begin to consume the egg shell around them. The little eating machine moves on to the leaves of plants chewing its way toward the next stage in life.

(Public domain photo)



A caterpillar may shed its skin four or more times as it eats and continues to grow. A caterpillar can travel a great deal eating and growing until it has reached the ideal size and has located just the right place to pupate. This stage is critical to the formation of the adult. Many biological changes take place during the pupal stage, which may last from a few weeks to several weeks. The species of butterfly and the outdoor climate impact the time in which the pupal stage is completed.

The magic that takes place inside the chrysalis is as remarkable as the beauty of the emerging butterfly. The outside of the chrysalis may appear to blend in with the foliage around it and remains still and protective of the mystery inside. The transformation that takes place completes the metamorphosis. The organs, tissues and limbs of the caterpillar are changed into the delicate wings and body of the elegant butterfly waiting to emerge. From the confines of the chrysalis, the butterfly emerges with soft, wet wings folded against its body. In a few hours the butterfly will have a body and wings that are ready to fly and begin the life of an adult.



(Photo by Linda Hoyer)

The unique environment at **Butterfly Wonderland** provides a perfect way in which to view the magic of the chrysalis. Numerous species of butterfly and moth chrysalis are located in the controlled atmosphere of the emergent gallery. The chrysalis viewing area is maintained under USDA regulations and is set up for

observing the miracle of the emerging butterfly.



Notice the variety of colors, shapes and sizes of the different species represented in the emergent gallery. The owl butterfly below has the distinctive “eye spots” on the wings.

(Photos by Linda Hoyer)



(Photo by Linda Hoyer)

The adult stage of the butterfly and moth is one filled with beauty and challenge. Just after the butterfly emerges from the chrysalis, it must have resting time to inflate the wings with a blood supply. The wings must also be given time to dry. In the wild, the butterfly is vulnerable during this resting period. Some species of butterflies and moths have colors and patterns that help disguise them from predators. For example, the owl butterfly has large eye spots that may appear to be

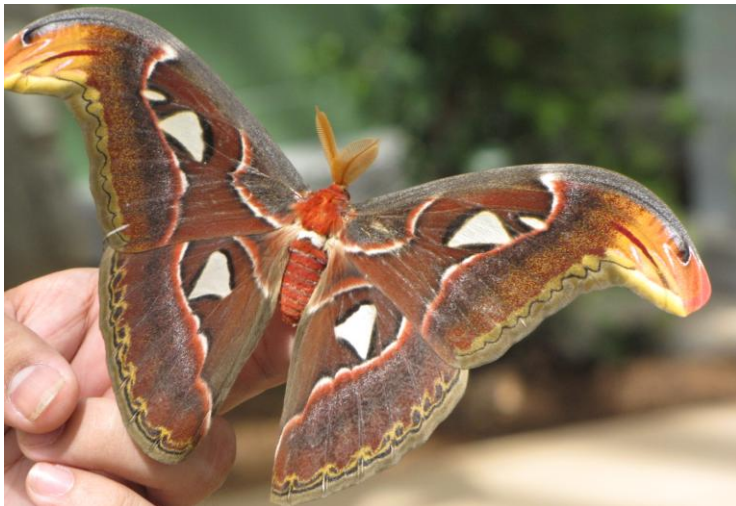


(Photo by Linda Hoyer)

the eyes of a bird to some predators. As an adult, the butterfly is focused on finding food, mating and continuing the life cycle.

The newly emerged Atlas Moth is brilliantly colored and carries a distinctive pattern on the wings. Notice the outer areas of the wings and how easily they might distract predators with their shape and coloration.

Ready for Flight!



(Photos by Linda Hoyer)

Butterfly Wonderland houses species of butterflies and moths from around the globe. The emergent gallery and atrium allow visitors to enjoy the splendor of nature at its finest. Observation of these amazing insects is greatly encouraged.

The Butterfly Wonderland Atrium – Beauty in Flight



(Photos by Linda Hoyer)

The Life Cycle of a Butterfly

1. Egg:

Butterfly eggs are usually laid on plants. They glue to a leaf and have a hard layer of shell to prevent water drying out of the eggs. The egg stage usually lasts several weeks before caterpillars come out from the eggs.



2. Caterpillars:

Caterpillars are also called butterfly larvae. They eat plant leaves and seem to eat food all their lifetime. Caterpillars have different shapes and will go through a series of stages called instars.



3. Pupa:

Caterpillars transform into pupas. At this stage, unlike a caterpillar, a pupa stops eating and goes through transformation into a butterfly. This process is called metamorphosis. During the metamorphosis process, the pupa body goes through abrupt changes. Butterfly wings start to grow out for flight.



4. Butterfly:

After the pupal stage, the adult butterfly has 4 wings and 6 legs. It may take up to 3 hours for the butterfly's wings to dry and then the butterfly can fly.



Butterfly behavior is more than fluttering in the air. Butterflies must stay warm by absorbing the heat from the sun. It is common to see butterflies “basking” in the sun while stretching their wings and sitting atop a rock or stone path in the garden. Butterflies will bask for a few seconds to several minutes depending on their need for warmth.

Butterflies spend much of their time in search of food. While they live mainly on nectar, butterflies and moths will also take in liquids from tree sap, rotting fruit, dissolved minerals in wet dirt, bird droppings and the dew on leaves.



Butterfly Wonderland

provides generous resources for the butterflies and moths to locate nourishment. This plate of diced fruit is a favorite.

(Photo by Linda Hoyer)

Butterflies are considered to be pollinators; however, they are not as efficient as bees. Butterflies like big, colorful flowers with petals that can be used like a landing strip to sit on as they sip up the nectar.

In the environment, butterflies are good indicators of the health of an ecosystem. Butterflies and moths are sensitive to changes in the environment and are impacted by climate changes. The decline in a population of butterflies or moths would be an indicator of concern for the biodiversity in the region. Because butterflies are a part of the food chain and food web, a decline in butterflies and moths would disrupt the food chain and potentially have a detrimental impact on other species of insects and animals in the region.

Butterflies and moths have many similarities. They are both insects and both are in the insect order, Lepidoptera. That means they both have scales on their body and wings, antennae, compound eyes and two sets of wings. Most butterflies fly during

the day and most moths fly at night. The butterfly antennae are thin with a club at the end. A moth has either a plain or feather-like antennae.



Note the feather-like antennae on the Atlas Moth. Many moths have a thick, furry body, whereas butterflies tend to have a slimmer body with no hair.



Butterfly antennae with the club or thickened end. Butterflies tend to be more brightly colored than moths.

(Photos by Linda Hoyer at Butterfly Wonderland)

Most moths have a tiny hook or fiber that holds their forewings and hind wings together. Butterflies do not have these hooks. Most moths spin a cocoon made of silk for the pupal stage. Butterflies form an exposed pupa, which is also called a chrysalis. Many species of moths have subtle colors that help camouflage them, while butterflies tend to be more colorful. There are exceptions to these characteristics, but in general, identifying the difference between butterflies and moths can be accomplished by observing these anatomical features.

Butterflies and moths are vulnerable to predators. Eggs, caterpillars and adults are tasty snacks for birds, rodents and reptiles. Over time, many butterflies and moths have evolved to disguise themselves and avoid becoming victims to predators looking for dinner. Eye spots on the wings appear scary to predators while distracting them from the vital parts of the moth's body. Some species have colors

that resemble the soil or host plants in the natural habitat. Another method of defense is by using mimicry. The butterfly blends in with the colors or patterns of toxic plants that certain predators have learned to avoid. Batesian mimicry is when a non-toxic species mimics a toxic species to avoid a predator. Mullerian mimicry takes place when predators learn to avoid certain colors or patterns that are toxic, and the butterfly or moth mimics the colors or patterns in its wings. Camouflage is another way in which butterflies, moths and caterpillars use the environment to maintain survival. One of the most camouflaged butterflies is the Indian Leafwing, which looks just like the leaves in their habitat.

Butterflies seem to make the world a little prettier. Fluttering in gardens, floating in air across the landscape, and sitting atop flowers and leaves, butterflies and moths have a place in songs, movies and literature. What would we do without them?



Lepidoptera are highly sensitive creatures when it comes to changes in the environment. Vanishing forests, pollution, loss of food supplies, changes in climate, severe storms and other natural disasters all have an impact on the survival of butterflies and moths. As numbers in a population drop off, the result can be the end of the species. Restoring habitats is one way in which people can have a positive impact on the butterfly and moth populations. Another way is to raise butterflies and moths in breeding programs and release them into the wild. Planting a butterfly garden is another way that families can attract and observe the natural phenomenon of the butterfly. (Photos by Linda Hoyer at Butterfly Wonderland)

Butterfly farming is considered by many to be a form of sustainable farming. Sustainable farming involves the effective use of nonrenewable resources. The basic premise is to meet the needs of the present without impairing the ability of future generations to have their needs met. Stewardship of both natural and human resources is a primary goal. Sustainable farming is a practice of farming ecologically.

Butterfly farms are generally found in tropical regions where the climate is conducive to raising butterflies year round. These colorful insects lend themselves to nature studies and biological research, which has led to establishing controlled conditions that provide a resource for exhibits of live insects. Insects are a renewable resource that can provide financial and economic incentives for the villagers and farmers in the area. Butterfly farming supplies an income while preserving and contributing in a positive manner to the habitat. Successful butterfly farming is currently taking place in South America, South Africa, China, Madagascar, Southeast Asia, Uganda, New Guinea and Australia.

The process of butterfly farming begins in a region that has a natural habitat and can be contained in areas that will allow butterflies and moths to live out their life in as much safety as possible. Most farmers place netting over the plants and trees to protect the caterpillars and assure ample food supplies. The caterpillars are checked routinely and collected as they begin pupation. The chrysalides are carefully wrapped with tissue and placed in a packing container for transportation to their destination. Butterflies are shipped in the chrysalis stage as it is the safest time in the life cycle.



(Photo by Linda Hoyer)

The containers are sent by express delivery to arrive in one or two days. Permits with strict regulations are required prior to the purchase and shipping of the butterfly chrysalis.

Butterfly Wonderland is a USDA approved facility and has met all of the regulations to handle butterflies and moths.

Each unique species of chrysalis is marked and packed with the utmost care. Most shipments arrive at the final destination in about three days. **Butterfly Wonderland** staff members begin the process of unwrapping each chrysalis as soon as the shipment arrives. The beautifully colored chrysalis varies in size, shape and color. Using a specialized chart and trained staff, each chrysalis is placed in a marked location to await the final stage of adult life.



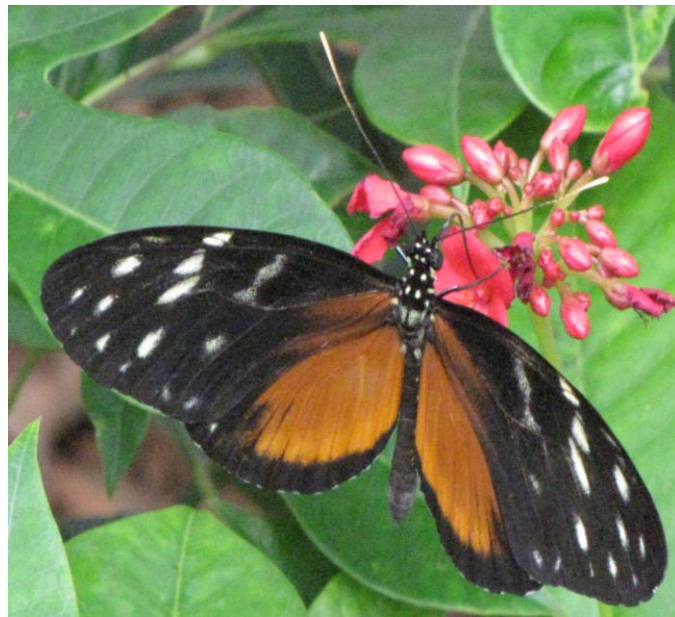
(Photo by Linda Hoyer)

The process of unwrapping is done with delicate hands as each chrysalis is prepared for hanging in the emergent gallery.

The emergent gallery is one of the largest in America and contains dozens of hanging chrysalis. The air temperature and moisture are monitored constantly to maintain the proper climate for the chrysalis. **Butterfly Wonderland** staff takes precautions to protect the integrity of the facility and the emerging butterflies.



(Photos by Linda Hoyer)



(Photos by Linda Hoyer – Butterfly Wonderland)

Planting a Butterfly Garden

Planting a garden that will attract butterflies will vary depending on the location, season of the year and butterflies native to the region. Research the butterflies that are native to the area and plan the garden accordingly.

Gardens can be any size, but consider the amount and location of water, the soil and the sun exposure in the location chosen. Container gardens will also attract butterflies and are a great choice for smaller spaces.

Steps:

- Determine the location and plot out the size of the garden (or container)
- Prepare the soil with products from the local garden center
- Select plants that are hardy and are considered host plants to the species of butterflies in the area

Suggested plants for the southwest:

Cosmos	Licorice mint	Sunflower	Desert marigold
Annual phlox	Deerweed	Marigold	Mallow
Zinnia	White sweetclover	Desert milkweed	Goldenrod
Lantana	Agave	Desert lavender	Citrus trees
Butterfly bush	Chastetree	Bird-of-paradise	
Baja fairy duster	Hackberry	Passionflower vine	

Butterfly Species in Arizona

Pipevine Swallowtail – Winter	Black Swallowtail – Summer
Giant Swallowtail – Winter	Checkered White – Summer
Sara Orangetip – Summer	Orange Sulphur – Summer
Southern Dogface – Winter	Cloudless Sulphur – Winter
Sleepy Orange – Winter	Gray Hairstreak – Summer/Winter
Spring Azure – Summer	Mormon Metalmark – Summer
American Snout – Winter	Mourning Cloak – Summer
Painted Lady – Winter	Red Admiral – Winter
Common Buckeye – Winter/Summer	
Monarch – Winter	Queen – Winter

(Note – There are other species that appear in the state for a brief time during summer or winter. The list does not include all species.)



(Photo by Linda Hoyer)

Zinnias are a hardy seasonal plant for the climate in Arizona.

Butterfly gardens are a wonderful hobby for all ages.



(Photo by Linda Hoyer)

Procedures and Pre-Activities:

1. State the learning objective.
2. Read related literature and discuss the anatomy and life cycle of butterflies and moths.
3. Ask open-ended questions about observations of butterflies and moths in the area.
4. Present the background information. Pause to ask and answer questions and show photos as needed.
5. Hand out the Life Cycle sheet and review the term complete metamorphosis as it relates to the butterfly.
6. Discuss the concept of migration and migration patterns.
7. Hand out the monarch butterflies migration map. Discuss the seasonal migration and explain that the adventure at Butterfly Wonderland will begin with a 3-D feature film about monarchs.
8. Prepare students to visit **Butterfly Wonderland, a Rainforest Experience**. Explain that students will visit one of the most unique places in Arizona with several exhibits related to butterflies and the rainforest.
9. Introduce the concept of sustainable farming and butterfly farming.
10. Suggest that students look for and identify butterflies and moths and notice the differences.

Activity: Each student receives one species identification card. While in the atrium at **Butterfly Wonderland**, students observe the different species and select one to identify. With assistance from the staff and using the handouts, students complete the identification card and make note of color, shape and size of the species they have selected. (Students may want to draw a picture of the species on the back of the card.)

Reflection and Assessment:

After visiting Butterfly Wonderland, discuss the experience in each of the exhibits. Discuss the atmosphere of the atrium as it relates to that of the rainforest.

Activity: Students research and discuss what is in an ecosystem. Give the “How does it all fit together?” sheet to students and arrange them in small groups.

Students use the computer to research the terms and relate them to the local environment and that of the atrium at **Butterfly Wonderland**.

Activity: Students research a specific species of butterfly and plot the migration pattern on the map of North America. Students write a description of the butterfly and the details of the species noting the same information they listed on the species identification card. (This species should be different than the one identified at Butterfly Wonderland.)

Activity: Using the Sonnet Worksheet, students write a sonnet about the butterfly species they selected to research.

Optional Activity: Planting a butterfly garden can be done as a class project or as an individual project at home. Students can be encouraged to take photos and drawings of the garden, listing plants and how they relate to attracting butterflies.

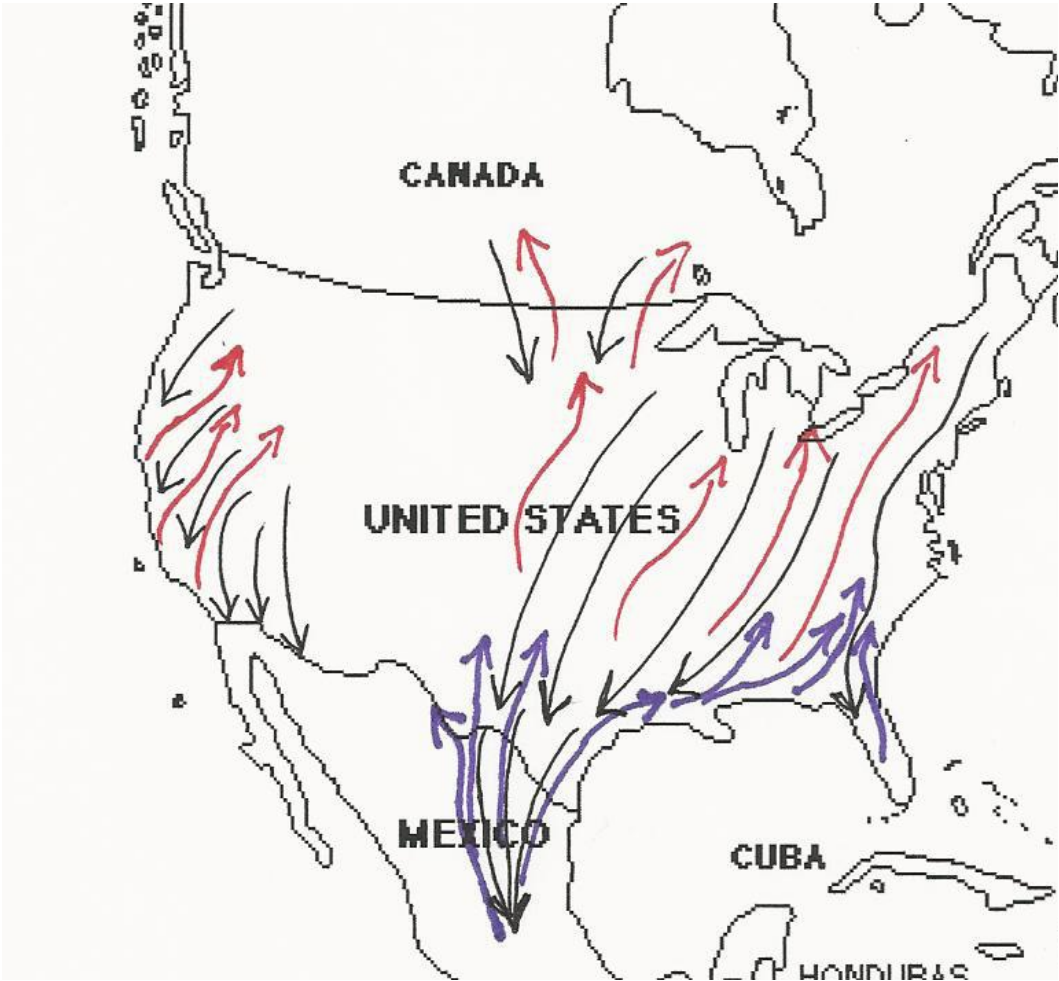
Writing Activity: Write a compare and contrast essay about butterflies and moths. This is both a group and individual activity. (See attached handout and outline for directions.)

Activity: Quick Study – Research the role played by butterflies and bees in the environment. Create a chart that lists the characteristics of butterflies and bees and their unique importance as they relate to the biodiversity in an ecosystem. (This activity can be developed into a writing assignment.)

Assessment: Participation, completion and points on activities are per teacher preference.

Sources: North American Butterfly Association (NABA); Butterfly Wonderland; University of New Hampshire – The Butterfly Farm; University of Tennessee; University of Michigan; Science Kids; Wikipedia; Thompson III, Bill and Toops, Connie. *Hummingbirds and Butterflies*. New York: Houghton Mifflin Harcourt Publishing Co. 2011; National Wildlife Federation; The Academy of Natural Sciences.

Monarch Migration in North America

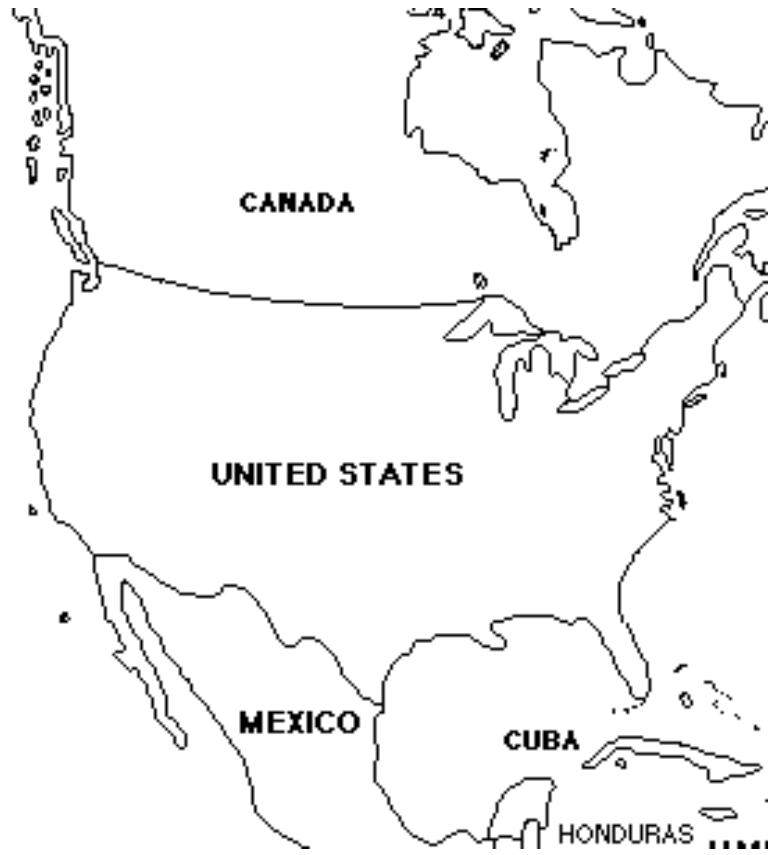


Fall = Black

Summer = Red

Spring = Purple

Migration Pattern Map



Name of Species: _____

Description of Migration Pattern: _____

Species Identification Card

Common Name: _____

Scientific Name: _____

Natural Habitat: _____

Migration Pattern: _____

Facts about the species: _____

Species Identification Card (Example)

Common Name: Blue Morpho Butterfly

Scientific Name: Morpho peleides

Natural Habitat: South America – rainforest areas

Migration Pattern: Blue morphos live in the tropical rainforest areas. They spend their lives, about 115 days, fluttering around the lower layers of the rainforest.

Facts about the species: The blue color on the wings is an example of iridescence, which means that the wing scales reflect light at a wavelength that appears blue.

How does it all fit together?

Define the following terms and explain how they interrelate.

Biome: _____

Biosphere: _____

Community: _____

Ecosystem: _____

Organism: _____

Population: _____

Species: _____

Explain how this all fits together: _____

Sonnet Worksheet

Sonnet Pattern:

Must be 14 lines

Must follow the rhyme scheme below

Must show some thought and effort

- Your first stanza should introduce the poem, explain a problem or situation, introduce what you will talk about.
- Your second stanza and third stanza should investigate the poem. What are the feelings involved? Exploring the story/conflict/situation introduced in the first stanza.
- Your rhyming couplet at the end should resolve the poem, or provide a dramatic twist to the story. The couplet is probably the most important two lines of the sonnet.

Write in Iambic Pentameter

(Five beats per line, words that go: DaDum, DaDum, DaDum, DaDum.)

Rough Draft Worksheet

First Stanza:

A

B

A

B

Second Stanza:

C

D

C

D

Third Stanza:

E

F

E

F

Rhyming Couplet:

G

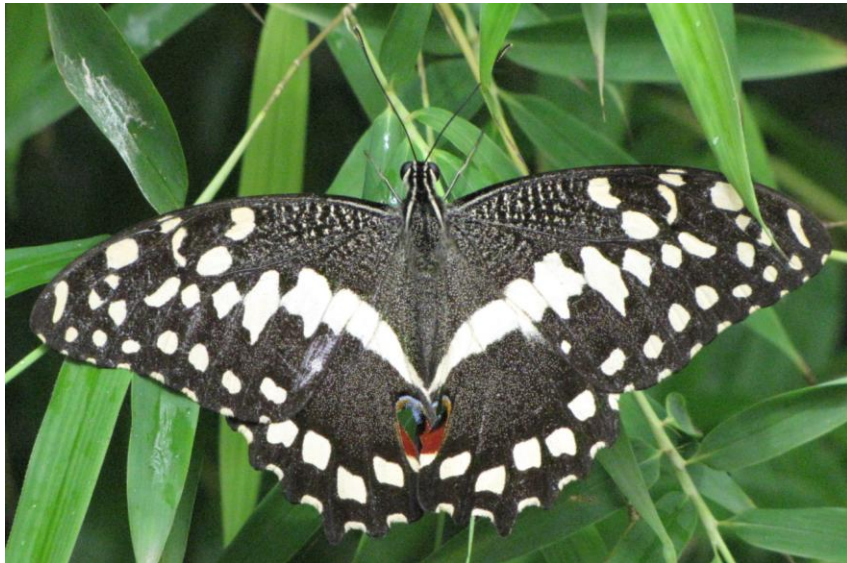
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Writing Activity: Compare and Contrast Butterflies and Moths

Begin with a group discussion regarding the specific characteristics of butterflies and moths. Using research and notes, list the similarities and differences as part of the pre-writing. Show examples of these traits to support your findings.

A Venn diagram is helpful as a visual pre-writing activity. Draw two large interconnected circles on a sheet of paper. Label one circle as “butterfly” and the other as “moth.” List the traits of each in the appropriate circle. The interconnected part of the circles is for the traits shared by both insects.

Write a compare and contrast essay about butterflies and moths.



(Photo by Linda Hoyer)

Compare and Contrast Essay

Introduction

- Present the subject that is to be compared or contrasted.
- End with a thesis statement that focuses the comparison and contrast.

Body Paragraph 1

- Include a clear topic sentence about similarities.
- Give supporting details to develop and support the main idea of the paragraph.

Body Paragraph 2

- Include a clear topic sentence about the differences.
- Give supporting details to develop and support the main idea of the paragraph.

Conclusion

- Summarize the similarities and differences and restate the thesis.