

American Museum of Natural History

EDUCATOR'S GUIDE

DAVIS FAMILY BUTTERFLY VIVARIUM

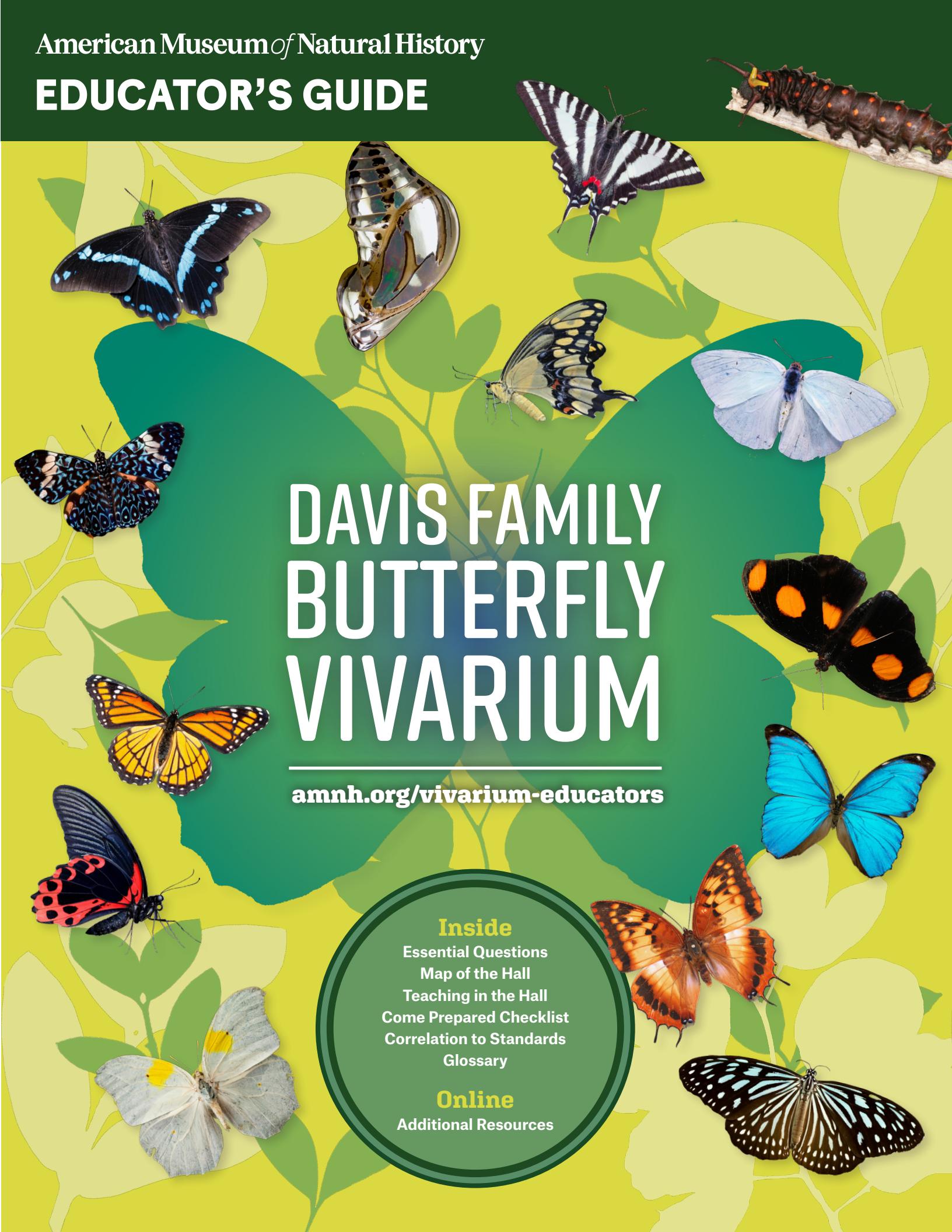
amnh.org/vivarium-educators

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ESSENTIAL QUESTIONS



What are butterflies and moths?

Butterflies are a subgroup of moths, insects belonging to the order Lepidoptera. The name comes from the Greek words *lepidos*, meaning “scale,” and *ptera*, meaning “wings”; the scales on butterfly wings are responsible for their beautiful colors and patterns. Almost all butterflies fly during the day, while most moths fly at night. Butterflies almost always have a bulb at the end of their **antennae**, while moth antennae come in many different shapes. And butterflies and moths have different pupae: A butterfly pupa, or chrysalis, has a bare, hard shell, while most moths wrap their pupa in silk, forming a cocoon. In their larval stage, butterflies and moths are called caterpillars.



How many kinds of butterflies and moths are there?

So far, scientists have described more than 18,000 butterfly species and more than 140,000 moth species. These are found on all continents except Antarctica. The first moths evolved about 200 million years ago, spreading and diversifying long before the first butterflies emerged about 60 million years ago. Most butterfly species inhabit the tropics, but many live in temperate and a few even in arctic regions. They range in size from the tiny eastern pygmy blue (*Brephidium isophthalma*) from the coastal southeastern United States, with its 5/8-inch wingspan, to the birdwings of New Guinea, with foot-long wingspans. Butterflies have striking diversity in their wing patterns. Sometimes these serve as **camouflage** to help butterflies escape the notice of predators. Often they warn predators that a butterfly is poisonous. And some nontoxic butterflies have evolved to **mimic** foul-tasting species, fooling predators into leaving them alone. Beyond their appearance, butterfly species vary greatly in their behavior. Most adults feed on nectar from flowers through their long, coiled, tube-like mouth parts (proboscis), but some species prefer rotting fruit, and a few even feed on feces or blood!

Why are butterflies and moths important?

Butterflies and moths play a vital role in **ecosystems** around the world. As caterpillars, they consume enormous quantities of vegetation and are an essential food source for many other animal species, especially birds. And because butterflies and moths are important **pollinators** in their adult form, many flowers evolved shapes, scents, colors, patterns, and nectar to attract them.

What is the life cycle of butterflies and moths?

Butterflies and moths undergo a four-stage process called complete **metamorphosis**:

1. Egg. A female seeks out a good spot to deposit its eggs, often a plant its caterpillars prefer to eat, called a host plant. Its eggs keep the developing embryo safe.

2. Larva (caterpillar). A hungry caterpillar crawls out of its egg and gets to work eating, shedding its skin as it grows. Caterpillars of some species end up 100 times larger than they started! As it eats, the caterpillar may stock up on chemicals, such as those that plants use to defend against their own predators. It may adapt those chemicals for other purposes, such as making itself poisonous in its adult form.

3. Pupa (chrysalis or cocoon). Once it's done eating and growing, the butterfly caterpillar makes a hard, protective case called a chrysalis to keep it safe, while the caterpillar of most moth species wraps itself in silk to form a cocoon. Inside this pupa, body tissue breaks down and reforms into wings, legs, and other adult parts.

4. Adult. The butterfly or moth emerges from its pupa in its adult form, ready to fly away, mate, and perhaps lay eggs of its own. Like most adult insects, it has three body regions (head, thorax, abdomen), two antennae, and six legs. It also has four wings, which are covered by colored and clear scales. It may use scents, colors, or dances to attract a mate. Some species **migrate** long distances. Monarchs, for example, sometimes travel about 3,000 miles! Over many generations they migrate from their wintering grounds in Mexico or California, traveling as far north as Canada until fall, when a final generation undertakes the long trip back.

How can we protect butterflies and moths?

Butterflies and moths face threats from human activity, including habitat destruction, climate change, and for some spectacular species, commercial collection. As a result, many species are endangered worldwide, including more than 25 species listed as endangered in the United States. Finding ways to slow climate change and mitigate its impact is essential to protecting them. Conservation biologists conduct research to learn as much as possible about the lives of butterflies and moths to figure out how to help them. Community leaders and policy makers work to preserve **habitats** and protect and revive endangered species. You can help by planting a butterfly garden at your school, in your yard (if you have one), or in a community garden. Choose plant species that attract adult butterflies by providing them with nectar and sites for laying their eggs, and that provide caterpillars with their preferred food.





MAP OF THE HALL

A vivarium is an enclosed area for keeping and raising live animals and plants in approximately natural conditions.

- Displays
- Thematic Text Panels

- ★ Nectar and Fruit Feeders
- Magnifiers

TEACHING IN THE HALL



When you and your students step into the Davis Family Butterfly Vivarium and follow the curving path through the greenery, you will be surrounded by brightly colored butterflies flying, eating, basking, resting, and occasionally alighting on a friendly arm or shoulder.

In this immersive space, students can note the distinctive colors and patterns of these insects, observe their natural behaviors, and talk about how their appearance might help these animals survive in their environment—for example, through camouflage, mimicry, or attracting mates.

You and your students will encounter:

Thematic Text Panels

Students can read short text passages and look for butterflies exhibiting the behaviors discussed in the text. Each theme is noted in the map.

Nectar and Fruit Feeders

Brightly colored feeding stations provide food to supplement nectar from the Vivarium's flowering plants. Students can try to spot butterflies sucking up fruit juice and sugar water through a straw-like appendage called a proboscis.

Magnifiers

Students can look through magnifiers to watch butterfly behavior, such as feeding on fruit juice.

1 Butterfly ID Cards

Every day, there are up to 80 different species of butterflies and moths in the Vivarium. Students can consult these panels to identify the species fluttering around them.

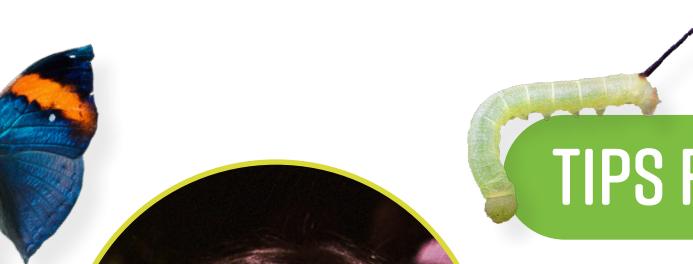
2 Pupae Incubator

In this glass case, students can observe butterflies of various species in the pupal—or chrysalis—stage. They can watch butterflies that may be emerging from the chrysalis and waiting for their wings to stiffen. They can also read about the four stages of complete metamorphosis in the panels along both sides of the incubator.

3 Moth Enclosure

The butterflies don't lay eggs in the Vivarium because their host plants are not available to them here, but the moths may lay eggs anywhere. To prevent moths from laying fertile eggs that could hatch and escape as caterpillars, any females are confined to this enclosure. When moths are present, students can observe their feathery antennae and compare them to the clubbed antennae of butterflies.





TIPS FOR A SUCCESSFUL VISIT



Prepare students for this immersive experience by sharing the following information with them before entering the Vivarium:



Look, but don't touch!

Butterflies are fragile and could get hurt. Don't chase them, move their food, or try to pick them up. Let them come to you.



If a butterfly lands on you...

Don't be afraid. Butterflies don't bite! You can let it stay on you as long as it wants, or ask a staff member to remove it.



It'll be warm and humid inside

The butterflies and moths in the Vivarium are tropical animals. To keep them healthy, the temperature is kept around 80°F with high humidity.



As you enter or leave the Vivarium...

You'll first enter a small vestibule where a staff member will check for any butterfly hitchhikers. Then you'll go through a second set of doors.

CONTINUE YOUR EXPLORATION

In the Gilder Center

Susan and Peter J. Solomon Family Insectarium

Students can explore the larger world of insects and get a sense of how butterflies and moths fit into it. They can look for butterflies and moths in the "Meet the Insects," "Attract and Warn," "Eat and Get Eaten," and "Mimic" sections.



Louis V. Gerstner, Jr. Collections Core

More than 3,000 specimens and artifacts are on display, and interior windows offer visitors glimpses of Museum researchers studying specimens. Students can examine Nabokov's Butterflies (2nd floor) and displays of insects, including butterflies and moths, and spiders (3rd floor). They may even spot an entomologist at work!



Online



Exhibition Website

amnh.org/exhibitions/butterflies

Read about butterfly behavior and conservation, watch a video about the butterfly life cycle, and find out how to grow your own butterfly garden.



Educator Resources

amnh.org/vivarium-educators

Find links to resources for teachers and students, including a Draw a Monarch activity and a story about the Butterfly Kingdom.

COME PREPARED CHECKLIST

- **Plan your visit.** For information about reservations, transportation, and lunchrooms, visit amnh.org/field-trips.
- **Read the Essential Questions** in this guide to see how themes in the Vivarium connect to your curriculum. Identify the key points that you'd like students to learn.
- **Review the Map and the Teaching in the Hall** section for an advance look at what your class will encounter.
- **Decide how your class will explore the Vivarium:**
 - You and your chaperones can facilitate the visit using the Teaching in the Hall section.
 - Students can use the Map to explore the hall on their own or in small groups.

CORRELATIONS TO STANDARDS

A Framework for K-12 Science Education

Disciplinary Core Ideas • ESS3.C: Human impacts on Earth systems • ESS3.D: Global climate change • LS1.A: Structure and function • LS1.B: Growth and development of organisms • LS1.C: Organization for matter and energy flow in organisms • LS2.A: Interdependent relationships in ecosystems • LS2.B: Cycles of matter and energy transfer in ecosystems • LS2.C: Ecosystem dynamics, functioning, and resilience • LS2.D: Social interactions and group behavior • LS3.B: Variation of traits • LS4.A: Evidence of common ancestry and diversity • LS4.B: Natural selection • LS4.C: Adaptation • LS4.D: Biodiversity and humans

Crosscutting Concepts • 1. Patterns • 3. Scale, proportion, and quantity • 4. Systems and system models • 5. Energy and matter: flows, cycles, and conservation • 6. Structure and function

Scientific & Engineering Practices • 1. Asking questions
• 6. Constructing explanations (for science) and designing solutions (for engineering) • 8. Obtaining, evaluating, and communicating information

CREDITS

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GLOSSARY



antennae: a pair of long, segmented sensory organs on the heads of butterflies and moths that help them smell, balance, and navigate

camouflage: an adaptation that allows an animal to blend into its surroundings, thus avoiding detection

ecosystem: all the living things in a given area (plants, animals, and other organisms), along with the components of their environment (things like air, water, and soil), interacting as a system

habitat: an area that provides the environmental factors necessary for members of a species to live and reproduce

metamorphosis: a biological process by which a post-embryonic animal undergoes an abrupt, rapid physical change from one stage to another. In **incomplete metamorphosis**, insects undergo three phases: egg, nymph, and adult; nymphs may resemble small adults. In **complete metamorphosis**, insects undergo four phases—egg, larva, pupa, and adult—and all phases are dramatically different in form. The larva of a butterfly or a moth is called a caterpillar. The pupa of a butterfly is called a chrysalis, and most moths form a silk-wrapped pupa called a cocoon.

migration: the regular, usually seasonal, movement of a population of an animal species from one region to another and back again; in some cases, such as monarch butterflies, migration can take place over several generations

mimicry: the similarity of one organism to another for the benefit of the mimic. In Batesian mimicry, a harmless species fools predators into avoiding it by evolving to resemble an unpalatable species. In Müllerian mimicry, multiple dangerous or unpalatable species evolve to resemble one another, thereby reinforcing their signal to predators to avoid them.

pollinator: an animal, such as an insect, that moves pollen from the male part (anther) of a flower to the female part (stigma) of the same or another flower, fertilizing the flower and allowing it to form a seed

IMAGE CREDITS

Cover: narrow green banded swallowtail, A. Hartl/AGE Fotostock; orange tiger pupa, Ingo Arndt/Minden Pictures; zebra swallowtail, Epantha/AGE Fotostock; pipevine swallowtail, Rick & Nora Bowers/Alamy; *Hamadryas arinome*, Danita Delimont/Alamy; giant swallowtail, John Serrao/Science Source; African migratory white, Nick Greaves/Alamy; viceroy butterfly, Sari O'Neal/Alamy; new world grecian shoemaker, Ger Bosma/Alamy; *Morpho melenaus*, The Natural History Museum, London/Science Source; scarlet Mormon, Fotosearch/AGE Fotostock; *Charaxes lasti*, Explore Collection/AGE Fotostock; *Anteos clorinde*, Marc Tielemans/Alamy; dark blue tiger, CSP/AGE Fotostock.
Essential Questions: malachite, E. Teister/AGE Fotostock; white veined white butterfly, MYN/Dirk Funhoff/NPL/Minden Pictures; owl butterfly eggs, Nature Picture Library/Alamy; death head hawk moth larva, Graham Ella/Alamy. **Map of the Hall:** *Atrophaneura semperi*, Danita Delimont/Alamy; *Hamadryas februa*, Jose Amorin; Atala, Jean Landry/Alamy. **Teaching in the Hall:** dead leaf, Design Pics/Alamy; Vivarium, feeder, magnifier, and pupae incubator, Alvaro Keding/©AMNH; cecropia moth, David Havel/Alamy; young girl with butterfly, Roderick Mickens/©AMNH; death head hawk moth larva, Graham Ella/Alamy; common green birdwing, Danita Delimont/Alamy; Collections Core and Insectarium, Matthew Shanley/©AMNH. **Back Cover:** red flasher, Andrew Neild; orange barred sulphur, Anke/AGE Fotostock; great Mormon, Zoonar/Felix Pergande/AGE Fotostock.