

Butterflies of the World

ZOOGUIDES volume 1

TEACHERS NOTES



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INTRODUCTION

The ZooGuides™ series of software from REMedia provides a resource for K-12 teachers and librarians on life science topics. This Teacher's Guide offers suggestions, activities, and references for integrating the Butterflies of the World ZooGuide into your curriculum. Other titles in the series include:

- Whales and Dolphins
- Mammals of Africa
- The Rainforest
- World of Reptiles
- Life in the Desert
- Animals in Danger
- Natural History of Yellowstone

Use this program:

- as an encyclopedic reference;
- to teach major biological concepts such as Evolution, Life Cycles, Classification, Reproduction, and Ecology; and
- to understand and appreciate the intricate and fascinating lives of butterflies.

What is in this Guide

The Butterflies of the World Teacher's Guide offers suggestions for incorporating the accompanying CD-ROM into Life Science and Biology classes. These ideas are divided into two general levels, K-6 and 7-12. Feel free to adapt any of the activities to meet your specific curricular goals (e.g., You may want to use a suggestion for a K-6 group that was written at a 7-12 level or vice versa).

In addition, this guide provides information on how to use the various sections of the program to complete activities, making the CD-ROM more useful than a mere reference tool. Read from a chapter, look at and listen to movies and use the chapters on the different butterfly groups to get a more complete picture of their lives.

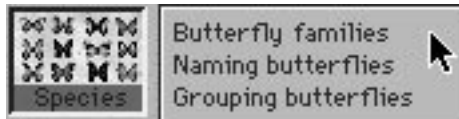
Finally, use this Teacher's Guide as a quick reference for the data provided in the ZooGuide. A list of helpful reference materials is provided so that your students can do more in-depth research once the program has sparked their imagination and interest.

USING THE BUTTERFLIES OF THE WORLD ZOOGUIDE

Navigating

There are “chapter” buttons on the left and right hand sides of your screen.

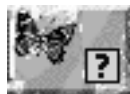
1. Click on a “chapter” button to access that “chapter”. When you click on your chosen “chapter” button a second time a list of subtopics will appear.



2. Click on the subtopic you are interested in and the information, including text and graphics will appear in the center of the window.
3. To choose a different “chapter” repeat steps 1 and 2 above.
4. By clicking on the ZooGuides logo button at the top right hand side of the screen you can view the Species “chapter” buttons by either their Latin name, common name, or picture.



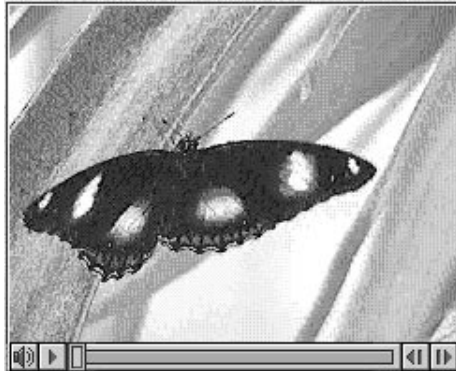
Getting Help



On-screen help is available. To access it, click once on the ? button located on the “Butterflies of the World” title bar as shown above. It uses text and graphics to explain the functions of the different sections of the program. Click on the same area again to return to the program.

Chapter topics have text. Most are accompanied by a movie or animation.

Playing Movies



To load the movie, click on the MOVIE button. This will bring up the movie window. To run the movie press the play button located under the picture. Use the other buttons to control the volume, to pause, or to jump forward or backward in the movie. To exit the movie simply click on the MOVIE button again.

Pictures

There are pictures accompanying the text for each of the individual butterfly species. Each is accompanied by a scale measure showing how large the butterfly is.

Viewing Photographs

Some of the individual species also contain photographs. Click on the PHOTO button and the photograph will enlarge. To exit the photograph simply click on it.

Viewing the Map

A map is provided for each type of butterfly family showing where they are found. Click on the MAP button. To exit the map simply click on the MAP button.

The pictures and photographs, movies, and text contained in the Butterflies of the World ZooGuide can be directly accessed from folders called BOW and Butterflies Text respectively; located in the same folder as the program icon. Use the pictures with the activities described in this Teacher's Guide or for other class projects.

Other Buttons

There are four other buttons in the viewing window. They allow you to:



print the current page of the ZooGuide,



get an index of all the butterfly species contained in the program,



quit the program, and



look at references.

Click once on a button to activate it.

INTEGRATING PARTS OF THE ZOOGUIDE

The Butterflies of the World ZooGuide has several zones of student-program interaction. They can be used singly or integrated to create more in-depth explorations of the program. For example, if students are learning about distribution of butterflies around the world, they can use the families chapters to view maps of where particular speices are found. This provides more in-depth information than if you use only one part or the other of the ZooGuide. It also provides a context for launching into additional research using references listed in the ZooGuide and at the end of this Teacher's Guide.

K-6 classes may want to use the parts of the program individually especially with younger students, increasing the integration with more interested or older students. The pictures, movies, and animation are probably the most useful parts of the program at this level. They provide interesting facts and attention grabbing footage.

7-12 classes can explore the chapters, text, graphics and individual species information separately or together depending on your focus. The activities included in this guide give other examples of how to integrate the parts of the ZooGuide to create projects and lessons that will motivate your students. It also provides suggestions for integrating Butterflies of the World into your Life Science or Biology curriculum.

ACTIVITIES FOR K-6 STUDENTS

This section of the Teacher's Guide offers 15 activities and ideas for integrating the Butterflies of the World ZooGuide into your life science curriculum. The activities range from making a model of a butterfly to exploring their use of camouflage.

Each activity lists the topic covered, the sources of information it will use, materials you will need, a step-by-step description of the activity, and discussion questions to help you conclude and find out what your students have learned in the process. Modify or edit these activities to tailor them to your specific needs. Also look at the 7-12 activities for other ideas and ways to use this ZooGuide with your students.

K-6 Activity 1:

TOPIC: Introduction to Butterflies

SOURCES: Students' knowledge of butterflies
Butterflies of the World ZooGuide

MATERIALS: Chalk board
Magazines with butterfly pictures
Scissors
Glue
Paper

ACTIVITY: In this activity students will answer questions to determine how much they know about butterflies. You should save this list and compare their responses with similar ones once they have completed the activities below. In addition, students can use magazine pictures of butterflies to make collages of their favorite ones. Ask your students the following questions and write their responses on the chalk board or an overhead projector. Save their responses for later discussion once they have used the ZooGuide.

1. What is a butterfly?
2. Where did they get this name?
3. What do they eat?
4. Have you ever seen any? What kind(s) were they?
5. How big are butterflies?
6. When do you see them most often?
7. What is a caterpillar?
8. How is it related to a butterfly?
9. What is a chrysalis?
10. What else do you know about butterflies?

Once students have answered these questions to the best of their ability they can peruse the ZooGuide to find out more about butterflies. They can use the photos contained in the ZooGuide's BOW folder to print pictures of their favorites or they can use magazines to find pictures of butterflies to cut out and glue onto paper making a collage.

DISCUSSION: As a group discuss the following as a wrap up of this activity.

1. Why are butterflies interesting?
2. What do you like most about butterflies? Why?
3. What don't you like about butterflies? Why?

K-6 Activity 2:

TOPIC: Camouflage or Hide and Seek

SOURCES: 'Large and Small' subtopic in the "Introduction" chapter in Butterflies of the World ZooGuide
Reference showing pictures of different butterflies
References listed at the end of this Guide

MATERIALS: Paper
Markers, colored pencils, or crayons

ACTIVITY: In this activity students will find hidden butterflies in pictures that you show them. They will also discover why some butterflies have this kind of adaptation.

Begin this activity by watching the movie in the Large and Small section of the Introduction chapter in the ZooGuide. It shows a butterfly that looks like a leaf. Find other pictures of butterflies that are adapted to look like their surroundings and ask your students to find the hidden butterflies. How well do the butterflies succeed in avoiding detection?

Many butterflies use camouflage to hide in nature to avoid being eaten. This camouflage can include looking like their surroundings, having large "eyespot" on their wings, or looking like a poisonous butterfly. Examples of these three types of camouflage are *Narope sarastro* and *Anaea archidona*, *Caligo oberthurii*, and *Limenitis archippus*, respectively. The *Narope* and *Anaea* both have wings that look like leaves. The *Caligo* has large eyespots on the under side of its wings. *Limenitis* is commonly called the Viceroy butterfly and it looks like a Monarch butterfly which is poisonous. Each of these butterflies, except the Viceroy are pictured in the ZooGuide. Show them to your students and ask them what they think the leaf-like wings and eyespots are for.

Students can now make a drawing of a butterfly in its natural surroundings with either an eyespot or drawn so that it is hidden somehow. Once they have drawn and colored their pictures they can exchange and see if other students can find the hidden butterflies.

DISCUSSION: As a group talk about answers to the following questions.

1. Why do some species of butterflies have eyespots on their wings?
2. Why do some butterflies have bright colors on their wings? Aren't they afraid of being eaten?
3. Why do Viceroy butterflies look like Monarch butterflies?

K-6 Activity 3:

TOPIC: Comparing Moths and Butterflies

SOURCES: 'Butterflies and Moths' a subtopic in the "Introduction" chapter in Butterflies of the World ZooGuide
References listed in this Guide or the ZooGuide

MATERIALS: Pictures of moths and butterflies
Paper
Markers, crayons, or colored pencils
Scissors
Glue

ACTIVITY: In this activity students will identify characteristics that distinguish moths from butterflies. They will use these characteristics to group pictures of moths and butterflies.

Begin this activity by showing students a picture of a butterfly (preferably a colorful one) and a moth. Ask them to list similarities and differences that they can observe from the pictures. Live or mounted specimens can be shown instead of pictures, if you have them available.

Once students list the compare features of each organism, they can read and watch the information presented in the Butterflies and Moths section of the Introduction chapter in the ZooGuide. This section lists specific characteristics that are used to distinguish moths from butterflies. How many of your listed characteristics match those mentioned in the ZooGuide?

Your students can now answer the following questions based on what they have observed and read.

1. What are three things that make moths different from butterflies?
2. How many of the Lepidoptera are moths?
3. How many of the Lepidoptera are butterflies?

To wrap up this activity, students can make drawings of moths and butterflies and label the parts that are similar and the parts that are different.

DISCUSSION: As a whole class discuss answers to the following questions.

1. Why do you think there are so many more moth species than butterfly species on earth?
2. Moths and butterflies are both classified as insects. What makes them insects like ants, beetles, and bees?
3. Why do you think that moths feed at night and butterflies feed during the day?

K-6 Activity 4:

TOPIC: Butterfly Life Cycle

SOURCES: "Life Cycle" chapter in Butterflies of the World ZooGuide
References listed in the ZooGuide and in these Teacher's Notes

MATERIALS: Drawing paper
Markers, crayons, or colored pencils
Tape or thumb tacks

ACTIVITY: In this activity students will apply the information they learn about butterfly life cycles to make a drawing showing the four stages of a butterfly's life.

Begin this activity by asking your students if they know how a butterfly is made. They may know about caterpillars and chrysalises. Once you have discussed what they already know, or think they know, watch and read the information provided in the Mating, Egg, Caterpillar, and Metamorphosis sections of the Life Cycle chapter in the ZooGuide. As students watch the information, they can take notes or make drawings to remember the facts presented and they can answer the following questions.

1. How long after mating do females lay their eggs?
(Females lay their eggs several weeks later.)
2. Why do butterflies lay lots of eggs? (They lay lots of eggs to make sure some survive being eaten by predators.)
3. Where do butterflies lay their eggs? Why? (Butterflies lay their eggs on the underside of leaves, because caterpillars eat the leaves.)
4. What comes out of the eggs? (Caterpillars emerge from the eggs.)
5. What are the three body parts of a caterpillar called? (The three parts are the head, thorax, and abdomen.)
6. Why are caterpillars called "eating machines"? (They got this name because all they do is eat and grow until they are large enough to change shape.)
7. When a caterpillar covers itself in a shell what is it called? (It is called a pupa or a chrysalis.)

8. How does a round, fat caterpillar become a thin, winged butterfly? (When it is a pupa it undergoes metamorphosis and caterpillar body parts become legs, wings, and antennae.)

Now that your students are familiar with the four stages of a butterfly's life, they can make a drawing showing the egg, caterpillar, chrysalis, and adult butterfly in their proper order and labeled. Draw them in a circle to show that the adults make eggs and the whole process starts over again.

As an extension of this activity your class could get a kit that allows you to observe the life cycle of a real butterfly from egg through adult. Students could keep track of which stage of life the butterfly is in and how long it spends in each stage of life. Make other observations and record them or keep a scientific journal.

DISCUSSION: What have your students learned from this activity? To find out, discuss the following questions as a group.

1. Name the four parts of a butterfly's life cycle in order.
2. Why do you think that butterflies have to be caterpillars before becoming butterflies?
3. Do humans go through similar life stages as butterflies do? What are they?

Butterfly Life Cycle Questions:

Name:

Date:

1. How long after mating do females lay their eggs?
2. Why do butterflies lay lots of eggs?
3. Where do butterflies lay their eggs? Why?
4. What comes out of the eggs?
5. What are the three body parts of a caterpillar called?
6. Why are caterpillars called "eating machines"?
7. When a caterpillar covers itself in a shell what is it called?
8. How does a round, fat caterpillar become a thin, winged butterfly?

K-6 Activity 5:

TOPIC: All Eggs are not Equal...

SOURCES: 'Egg' subtopic in "Life Cycle" chapter in Butterflies of the World ZooGuide
References listed in the ZooGuide and in these Teacher's Notes

MATERIALS: Magnifying glasses
Butterfly eggs
Paper
Pencil

ACTIVITY: In this activity students will identify the characteristics of different butterfly eggs.

Students should watch and read the information presented in the Egg section of the Life Cycle chapter in the ZooGuide. The movie shows several kinds of eggs. Ask students to describe them and draw the shapes they see.

Next, if it is spring and your school is in an area where you can take a field trip to a field, take your class out to hunt for butterfly eggs. They should be armed with magnifying glasses, paper, and a pencil so that they can draw what they see. Do not let them remove the eggs and try to disturb as little as possible.

If taking a field trip to a field is not possible for your class there are several alternatives: go to the local zoo and check out their butterfly area or find a butterfly garden near you. A list of them is provided in the ZooGuide.

Click on the Resources button and a list of butterfly gardens of the world appears. Find the one nearest you and call them to find out if they have eggs available to see.

A third alternative to going on a field trip is to order butterfly eggs to begin growing them in class. Check with the biological supplies company that your school uses and see if they carry butterfly eggs.

DISCUSSION: Once you have a source for butterfly eggs, students can answer the following questions.

1. Where are butterfly eggs found? Why? (give at least three reasons)
2. Why do eggs of different species look different?
3. What do you think the ridges on some eggs do?
4. How many different kinds of butterfly eggs did you see on your field trip?
5. Where they hard to find? Why?

K-6 Activity 6:

TOPIC: Butterfly Model

SOURCES: 'Body Regions' subtopic in "Body Plan" chapter in Butterflies of the World ZooGuide
References listed in the ZooGuide and in these Teacher's Notes

MATERIALS: Clay
Pipe cleaners
Tissue paper
Sequins
Paper machè
Paint, markers, colored pencils

ACTIVITY: In this activity students will use the information provided in the ZooGuide to make an accurate model of a butterfly. They will learn about body structures as they come up with creative ways to make them for their models.

Begin by asking students to name the parts of a butterfly. Make a list on the chalk board or overhead projector. Next, watch and read the information presented in the Body Regions section of the Body Plan chapter in the ZooGuide and complete the list of butterfly body parts. Your list should now include the following: eyes, antennae, proboscis, head, thorax, abdomen, wings, and legs.

Using the materials listed above, students should come up with creative ways of constructing a butterfly model. They can work in groups or alone to do this. Once the models are completed, students should label the parts of the body and display the butterflies around the room. Use these models to compare butterflies with other insects or other animals that you study.

DISCUSSION: As a group discuss answers to the following questions to conclude this activity.

1. What did you learn about butterfly anatomy that you didn't know before?
2. How are butterflies similar to other insects? How are they different?
3. What was your favorite part of building the butterfly model? Why?

K-6 Activity 7:

TOPIC: Butterfly Feeding Habits

SOURCES: 'Feeding' subtopic in "Body Plan" chapter in Butterflies of the World ZooGuide
'Feeding' subtopic in "Ecology" chapter in Butterflies of the World ZooGuide
References listed in the ZooGuide and in these Teacher's Notes

MATERIALS: Paper
Pen or pencil

ACTIVITY: In this activity students will explore the eating habits of butterflies. Ask your students the following questions and record their answers on the chalk board to refer to later in the activity.

1. What do caterpillars eat?
2. What do butterflies eat?

Now students can watch and read the information provided on feeding in the Feeding Sections of the Body Plan and Ecology chapters in the ZooGuide. They should write down information to answer the following questions.

1. What do caterpillars eat? (leaves of one or two kinds of plants)
2. What do butterflies eat? (nectar from flowers of plants and sometimes honey dew or juices from dead animals)
3. Why are cabbage butterflies considered pests? (because they eat cabbage, broccoli, and cauliflower plants that farmers grow to sell)
4. What is the name of the tube that butterflies use to eat? (proboscis)

Once they have finished doing their research, they can compare the answers they found in the ZooGuide with the ones they came up with earlier. Where their answers accurate? What did they have misconceptions about?

DISCUSSION: To conclude this activity students can discuss these open-ended questions as a group.

1. Why do you think caterpillars and butterflies eat different parts of plants?
2. What would happen if a butterfly laid its eggs on the wrong kind of plant?
3. What other organisms do butterflies have to compete with to get food from flowers?

K-6 Activity 8:

TOPIC: Name That Butterfly

SOURCES: 'Distribution' subtopic in Ecology chapter in Butterflies of the World ZooGuide
Species Index in Butterflies of the World ZooGuide
References listed in the ZooGuide and at the end of this guide

MATERIALS: Paper
Pen or pencil

ACTIVITY: In this activity students will identify various butterflies shown in the ZooGuide using the Species Index and other references to find their names. Once they have found a match they will also discover whether or not it migrates and where it lives.

Begin this activity by dividing your class into small groups. Each group can watch the movie in the Distribution section of the Ecology chapter in the ZooGuide. They can use the pause button to get a good look at each butterfly as it is shown. They can record its characteristics on the chart provided to make looking it up in the Species Index easier.

Next, your students can try to find each butterfly in the Species Index or a reference book listed in this guide. Once they think they have identified all of the butterflies, they can fill in the name, location, and whether or not it migrates on the chart.

The butterflies shown in the movie are: 1) *Dryas julia* (Flame) found in Central and South America, 2) *Idea jasonia* (tropical Danaid) found in India, 3) *Heliconius charitonius* (Zebra) found in Central and South America, 4) *Heliconius erato* (Small Postman) found in South America) and 5) *Danaus plexippus* (Monarch) which lives in North America and migrates to Central America in the winter.

DISCUSSION: Once your students have filled in their charts they can compare their findings with the rest of the class. Then you can discuss the following questions.

1. Do all of the students agree on the types of butterflies shown? If not, which ones are in dispute?
2. Which butterfly was the hardest to find? Why?
3. Which of these butterflies migrates? What do the others do in winter?
4. What are the advantages of migrating versus hibernating? What are the disadvantages?

Name That Butterfly Chart

Name:

Date:

Description	Name (Latin and Common)	Home	Migrate ?
1.			
2.			
3.			
4.			
5.			

K-6 Activity 9:

TOPIC: Hibernation

SOURCES: 'Climate' subtopic in Ecology chapter in Butterflies of the World ZooGuide
References listed in the ZooGuide and at the end of this guide

MATERIALS: Paper
Pen or pencil

ACTIVITY: In this activity students will define hibernation, identify butterflies that hibernate, and explain why they do.

Begin this activity by asking your students if they know what hibernation means. Write down their ideas for later discussion and if you have a story about a hibernating animal, read it to them.

Students can watch and read the information provided in the Climate subsection of the Ecology chapter in the ZooGuide and then answer the following questions about hibernation.

1. What kinds of animals hibernate? (Bats, frogs, butterflies, rodents, hummingbirds, etc.)
2. Why do they hibernate? (food is not available, it is cold and they need to conserve energy, they are cold blooded, etc.)
3. When in a butterfly's life cycle can it hibernate? (in any part — as an egg, a caterpillar, a pupae, or an adult)
4. What does hibernation mean according to the ZooGuide? (Hibernation means resting to conserve energy.)

Once students have answered these questions, go back to your original definition of hibernation and discuss any changes you should make to it. How accurate was your first definition? How did you improve it after students had read and listened to the information in the ZooGuide?

DISCUSSION: When you have completed the above activity and reviewed the answers to the questions, gather your class as a group to discuss the following questions.

1. Which of the four stages in a butterfly's life do you think would be the easiest to hibernate in? Why?
2. What is a possible alternative to hibernation? Name a butterfly which migrates in winter.
3. What do butterflies do on hot days to keep cool?

K-6 Activity 10:

TOPIC: Migration

SOURCES: 'Migration' subtopic in Ecology chapter in Butterflies of the World ZooGuide
References listed at the end of this guide and the ZooGuide

MATERIALS: Map of North and Central America
Markers, colored pencils, or crayons
Scissors
Glue
Pen or pencil

ACTIVITY: In this activity students will plot the course of migrating butterflies as they travel south for the winter and back north for summer.

Begin this activity by watching and reading the information provided in the Migration subsection of the Ecology chapter in the ZooGuide which shows monarch butterflies migrating in the fall and spring. Students should record where the butterflies go, how far they travel, and where they stay for the winter.

Pass out maps of North and Central America which show geo-political lines as well as land features if possible. Ask your students to use colored markers, pencils, or crayons to show the southward path of the migrating butterflies. Use a different color to show their return trip in the spring. Add a legend to the map showing the color code for each leg of the trip. Students can print pictures of monarch butterflies from the ZooGuide, color them, and paste them on the map to illustrate their flight paths.

DISCUSSION: Once students have completed their maps, you can get together as a group and discuss the answers to the following questions. (Use references to help you answer some of these questions.)

1. What does migration mean?
2. How far do monarchs travel each year?
3. How long do you think an individual monarch butterfly lives?
4. Why do they migrate?
5. What are the advantages of migrating versus hibernating?
6. What are the disadvantages of migrating?

K-6 Activity 11:

TOPIC: Butterfly Families

SOURCES: 'Butterfly Families' subtopic in Species chapter in Butterflies of the World ZooGuide
Species Index in Butterflies of the World ZooGuide
References listed in the ZooGuide and this guide

MATERIALS: Paper
Pen or pencil

ACTIVITY: In this activity students will explore the Species Index and find answers to the following questions.

1. What is the common name of the Amathissiidae family?
(Palm King)
2. What is the name of the family with Monarch butterflies?
(Danaiidae)
3. What is the genus and species name of the Monarch?
(*Danaus plexippus*)
4. Choose a butterfly from the Nymphalidae family. Describe it, write its common name, Latin name, and print a picture of it.
5. Look at all the pictures of butterflies shown in the Species Index. Choose your favorite one. Write down its common name, Latin name, and family name. Exit the program and open the BOW folder on the CD then open the PICT folder. Find your butterfly and print its picture. Use markers, colored pencils, or crayons to color it and write its name at the bottom of the paper. Hang your picture on the bulletin board or on a wall of the classroom.

DISCUSSION: When students have finished finding the above information, you can review their answers. As a group you can then discuss the following open ended questions.

1. Why are butterflies so interesting to people?
2. What did you learn from this activity?
3. Do you feel more comfortable using the Species Index now that you have completed this activity? Why or why not?

Butterfly Families Worksheet

Name:

Date:

Directions: Use the information from the Species Index to answer the following questions.

1. What is the common name of the Amathissiidae family?
2. What is the name of the family with Monarch butterflies?
3. What is the genus and species name of the Monarch?
- 4
 - a. Choose a butterfly from the Nymphalidae family.
 - b. Describe it.
 - c. Write its common name.
 - d. Write its Latin name.
 - e. Print a picture of it.
- 5
 - a. Look at all the pictures of butterflies shown in the Species Index.
 - b. Choose your favorite one.
 - c. Write down its common name, Latin name, and family name.
 - d. Exit the program by clicking on the Quit button.
 - e. Open the BOW folder on the CD then open the PICT folder.
 - f. Find your butterfly and print its picture.
 - g. Use markers, colored pencils, or crayons to color it and write its name at the bottom of the paper.
 - h. Hang your picture on the bulletin board or on a wall of the classroom.

K-6 Activity 12:



TOPIC: Where can I see these butterflies?

SOURCES: Species Index in Butterflies of the World ZooGuide
References listed in the ZooGuide and at the end of this guide

MATERIALS: Paper
Pen or pencil
World map
Markers, crayons, or colored pencils
Scissors
Glue

ACTIVITY: In this activity students will use a feature of the Species Index to find out where families of butterflies live in the world.

Begin this activity by familiarizing your students with the Species Index in the ZooGuide, if they are not already. Use the button of the boy with the balloon coming out of his mouth which says "Where can I see these butterflies?" to find a butterfly family that lives on each of the world's continents (excluding Antarctica which can not sustain butterflies).

Below is the list of the six continents where butterflies are found and the families that live there. Once your students have found at least one family per continent, you can pass out a world map to each student or group of students to put this information on the map. They can choose representatives from each butterfly family, print, color, and paste them on the map. Then they can label the family name, genus and species names, and the common name of the butterflies they chose.

1. North America — Libytheidae, Nemeobiidae, Satyridae
2. South America — Brassolidae, Heliconidae, Ithomiidae, Morphidae, Nemeobiidae
3. Europe — Nymphalidae, Pieridae
4. Asia — Danaidae
5. Africa — Acraeas
6. Australia — Amathusiidae, Danaidae, Libytheidae, Papilionidae

Students can make their maps as colorful as they want. They can create a map legend with color coding showing where the different families of butterflies live. Hang the maps around the room as a reminder of the many places that butterflies can be found.

DISCUSSION: Once students have finished the above activity, they can answer the following questions as a group.

1. Where do the largest butterflies in the world live? Why?
2. In your opinion, where in the world do the prettiest butterflies live?
3. Why do you think that most of the butterfly families live on warm continents like Australia and South America?

K-6 Activity 13:

TOPIC: Research Paper

SOURCES: Species Index in Butterflies of the World ZooGuide
Butterflies of the World ZooGuide
References listed in the ZooGuide and at the end of this guide

MATERIALS: Paper
Pen or pencil
Markers, colored pencils, or crayons
Scissors

ACTIVITY: In this activity students will write a research paper on one of the 15 families of butterflies listed in the Species Index of the ZooGuide. They can work in groups or alone and can be assigned a family to research or they can choose their own, as long as all 15 are represented in the class.

The following are a list of suggested data that students can gather for their research. Add to or delete from this list as you see fit.

1. Number of species in this family.
2. Range of sizes of members of this family.
3. Where they live.
4. What types of plants they eat.
5. What defenses they have against predators.
6. Include a drawing or photograph of representative members of the family.
7. Characteristics scientists use to group members of this family. (e.g., antenna shape, wing coloration, body shape, feeding habits, etc.)
8. When in their life cycle the butterflies hibernate, if at all.
9. Life span — How long are they a caterpillar, a pupae, a butterfly?

Students or student groups should combine the information they gather on the above topics into a well formed essay to be presented to the class or kept with the ZooGuide for future classes to use in their research.

DISCUSSION: To conclude the above activity, gather your students and discuss the following questions.

1. Which family of butterflies do you think is the most diverse? Why?
2. What did you learn about butterflies that you didn't know before you wrote this paper?
3. Add one question to the list above for future classes to include in their research papers.

K-6 Activity 14:

TOPIC: Butterfly Story

SOURCES: Butterflies of the World ZooGuide
References listed in the ZooGuide and this teacher's guide

MATERIALS: Paper
Pen or pencil
Markers, crayons, or colored pencils
Scissors
Glue

ACTIVITY: In this activity students will write original stories or plays about a butterfly of their choice using the ZooGuide and other reference materials to add accuracy and facts to the story. Brainstorm ideas with your class about which to write; a story or a play. You can write the story or play as a whole class, in small groups, or individually. Some ideas for stories and plays include:


1. writing about a monarch butterfly's adventures migrating south for the winter and north again in spring. Maybe one meets a long lost friend and shares the hard trip with him. Maybe she gets lost and loses the group as they fly south and a kind human helps her through the cold winter.
2. writing about a tropical rain forest butterfly and how it survives in a place where birds, bats, and monkeys want to eat it. OR
3. writing about a person who collects rare and beautiful butterflies, but realizes one day how wrong it is to kill them because there are so few left in the wild. Maybe this person creates a butterfly garden where he raises rare butterflies for people to enjoy in their natural state.

Think of other ideas and then let students pick their favorite one to write the story or play about. Stories can be any length depending on the group you are working with and how much time you have for the activity. Make sure to use facts from the ZooGuide to help make the stories more real and use the print feature to get pictures of butterflies to add to the stories for visual content. Display the stories around the room for all your students to read and enjoy or have a story time where students read their stories to the class. If students have chosen to do a play, set aside time for them to perform it for the class.

DISCUSSION: Once students have read or performed their stories for the class ask everyone to participate in an assessment of what they think of the stories. You should encourage them to be positive about their criticisms and to offer support for stories they especially like.

K-6 Activity 15:

TOPIC: Butterfly Gardens

SOURCE:  Resources section in the Butterflies of the World ZooGuide

MATERIALS: Paper
Pen or pencil
World map
Markers, crayons, or colored pencils
Scissors
Glue

ACTIVITY: In this activity students will visit a butterfly garden or zoo in your local area to learn more about their habitats and see them in person.

Begin this activity by finding a butterfly garden near you using the Resources button in the ZooGuide. It is located in the lower left corner of the main screen. Click on the button and a list of reference books, butterfly gardens, and other CD ROM titles appears. Scroll down to US butterfly gardens or those listed for your country and look for one in your state or a city near your school. If there isn't a butterfly garden listed that is near your school, check with your local zoo and see if they have a butterfly exhibit.

Now that you have located a garden or zoo to see live butterflies at, you can plan a field trip for your class. They can visit the butterfly garden with their considerable knowledge about butterflies that they have learned from doing previous activities in this guide. Students should bring drawing paper with them to the garden or zoo so they can record what they see. If you have access to a camera, bring it as well to take pictures of the various butterflies and habitats displayed.

When you return to the classroom from your field trip, you and your students can construct a bulletin board showing all that you learned on your trip to the butterfly garden. Use photographs, drawings, and any notes you took to recreate the atmosphere of the garden on your bulletin board. Use construction paper to make grass, flowers, and trees. Cut out pictures of butterflies from photographs, drawings students made, or from the ZooGuide to paste onto your butterfly habitat. Try to make the scene as authentic as possible. Include butterflies in various stages of life such as eggs, caterpillars, chrysalises, and adults. Finally, label the parts of your scene with names of plants, butterflies, and anything else you have included.

DISCUSSION: Discuss the following open ended questions once you have completed the bulletin board.

1. What was your favorite part of the butterfly garden/zoo? Why?
2. Why are butterfly gardens important?
3. What else would you like to learn about butterflies now that you have studied the Butterflies of the World ZooGuide?

ACTIVITIES FOR 7-12 TEACHERS

This section of the Teacher's Guide offers 15 activities and ideas for integrating the Butterflies of the World ZooGuide into your Biology curriculum. The activities range from evolution to reproduction in butterflies.

Each activity lists the topic covered, the sources of information used, a step-by-step description of the activity, and a conclusion section with questions to help you find out what your students have learned in the process. Modify, delete, or edit these activities to tailor them to your specific needs. You can also look at the K-6 activities for other ideas and ways to use the ZooGuide with your students.

7-12 Activity 1:

TOPIC: Butterfly Evolution

SOURCES: 'Butterfly Evolution' subtopic in Introduction chapter in Butterflies of the World ZooGuide
References listed in the ZooGuide and at the end of this teacher's guide

ACTIVITY: In this activity students will research the connection between flowering plant and butterfly evolution. They will make a case for the late appearance of butterflies coinciding with the appearance of flowering plants in geologic history.

Use this activity when studying Co-Evolution, Insects or Flowering Plants.

Begin this activity by asking your students what caterpillars and butterflies eat. Then read and view the information presented in the Butterfly Evolution subsection of the Introduction chapter in the ZooGuide.

Why does the ZooGuide surmise that butterflies evolved so recently?

Students can do some research on when flowering plants first arose on earth and when butterflies first evolved as well. Then answer the following questions.

1. What is the correlation, if any between these two events?
2. What parts of the butterfly are specifically evolved for feeding on flowering plants?

3. How are butterfly caterpillars and eggs also evolved for dependence on flowering plants?
4. What adaptations have flowering plants made to accommodate butterflies? Why?

Once students have answered these questions they can write an essay including all the information they have gathered. They can include illustrations to show how flowering plants and butterflies have influenced each others evolution.

CONCLUSIONS: Students can share their findings with the class by presenting their essays. Discuss any discrepancies between findings and clear up any misconceptions at this time about butterfly evolution.

7-12 Activity 2:

TOPIC: Comparing Flying Insects

SOURCES: 'Butterflies and Moths' subtopic in Introduction chapter in Butterflies of the World ZooGuide
'Body Regions' subtopic in Body Plan chapter in Butterflies of the World ZooGuide
References listed in the ZooGuide and at the end of this guide
Your Biology textbook

ACTIVITY: In this activity students will compare butterflies to other flying insects to determine how similar and different body plans can be and still achieve the fundamental ability to fly.

Use this activity in conjunction with studies of Insects or Adaptation.

Begin this activity by asking students to name as many flying insects as they can. Their list should include butterflies, moths, bees, flies, wasps, some beetles, mosquitoes, gnats, etc.

Find pictures of each of these types of flying insects and compare their basic body structures. Read and watch the information provided in the Butterflies and Moths subsection of the Introduction chapter in the ZooGuide and the Body Regions subsection of the Body Plan chapter to begin to get an idea of the types of similarities and differences you will find. Then answer the following questions.

1. What common elements do you notice?
2. How are butterflies different from other flying insects?
3. How are butterflies similar to other flying insects?

CONCLUSIONS: Discuss the answers to the above questions as a group and then answer these open ended questions.

1. Why are butterflies and moths the second largest group of insects in the world?
2. Why do you think butterflies evolved such large bright wings compared with other flying insects?
3. What accounts for butterflies success as flying insects?

7-12 Activity 3:

TOPIC: Butterfly Life Cycle

SOURCES: Life Cycle chapter in Butterflies of the World ZooGuide
References listed in the ZooGuide and at the end of this guide
Your Biology textbook

ACTIVITY: In this activity students will become familiar with the four stages in a butterfly's life cycle and describe other organisms that have similar ones.

Use this activity when studying Life Cycles, Reproduction, or Insects.

Begin this activity by asking your students to name the stages in a butterfly's life. They should list egg, caterpillar, pupa or chrysalis, and adult. Save their list whether or not it is complete and ask them to look through the Life Cycle chapter in the ZooGuide in small groups or individually. They can answer the following questions to check their understanding of the information presented.

1. How do male butterflies attract females? (with smells called pheromones)
2. How long after mating do females lay their eggs? (several weeks later)
3. How is an egg that will hibernate different from one that won't? (its shell is stronger to withstand many months as protection for the caterpillar)
4. Why do butterflies lay large numbers of eggs? (to make sure that some survive predation)
5. Why are eggs laid on the underside of leaves? (give three reasons) (to protect them from the sun, to protect them from predators, and to provide easy access to food when the caterpillar emerges)
6. What are the three body parts of a caterpillar? (head, thorax, and abdomen)
7. What is a caterpillar's job in the life cycle? (to eat and grow large enough to metamorphose)
8. When a caterpillar covers itself in a shell what is it called? (a pupa or chrysalis)

9. How does a round, fat caterpillar become a thin, winged butterfly? (The repeating segments of the caterpillar's body specialize to form legs, wings, and antennae in the adult butterfly. This process is called metamorphosis.)
10. According to the ZooGuide, what process is the beginning and end of a butterfly's life cycle? (mating)

Check students' answers to the above questions and discuss any discrepancies. Use other references to find organisms that have similar life cycles to butterflies. What do they all have in common?

CONCLUSIONS: Conclude this activity by discussing the following open ended questions.

1. What are some advantages to a life cycle with an intermediate like a caterpillar that is self sufficient and independent from its parents?
2. Are there any parallels between a butterfly's life cycle and a human's? What are they?
3. What are some evolutionary advantages to this kind of life cycle?

Butterfly Life Cycle Worksheet

Name:

Date:

Directions: Answer the following questions using the Life Cycle chapter in the Butterflies of the World ZooGuide.

1. How do male butterflies attract females?
2. How long after mating do females lay their eggs?
3. How is an egg that will hibernate different from one that won't?
4. Why do butterflies lay large numbers of eggs?
5. Why are eggs laid on the underside of leaves? (Give three reasons.)
6. What are the three body parts of a caterpillar?
7. What is a caterpillar's job in the life cycle?
8. When a caterpillar covers itself in a shell what is it called?
9. How does a round, fat caterpillar become a thin, winged butterfly?
10. According to the ZooGuide, what process is the beginning and end of a butterfly's life cycle?

7-12 Activity 4:

TOPIC: Butterfly Reproduction

SOURCES: 'Mating' subtopic in Life Cycle chapter in Butterflies of the World ZooGuide
Species Index in Butterflies of the World ZooGuide
References listed in the ZooGuide and at the end of this guide
Your Biology textbook

ACTIVITY: In this activity students will discover the anatomy of butterfly reproduction and the male and female components of the process.

Use this activity when studying the reproduction of insects.

Let your students choose a butterfly species to study or assign them one from each of the 15 families of butterflies discussed in the ZooGuide. They can do research about reproductive habits in that species and compare their findings with other members of the class to get an idea of the wide range of approaches to mating used in the butterfly world.

Students can work in groups or alone to conduct their research. They should begin with the information provided in the Mating section of the Life Cycle chapter in the ZooGuide and continue by looking up their species in the Species Index or Index of the ZooGuide. They will probably need to gather additional information from a resource listed in the ZooGuide or at the end of this Guide. To use the references listed in the ZooGuide students should click on the Resources button located in the lower left corner of the main screen of the ZooGuide. This will display a list of references.

Student research should address the following questions and any others you want to add.

1. How does the male attract the female in this species?
2. How long do the male and female engage in sexual intercourse?
3. How many eggs does the female typically lay?
4. On what types of plants does the female prefer to lay her eggs?
5. Describe the courtship ritual used by this species.
6. Does wing coloration play a role in the mating ritual of this species? If so, what role?
7. How long do the adults live after mating?
8. At what time of year do members of this species mate? Why?

When students have found answers to these questions they can assemble their findings in essay form and present them to the class. This will allow them to make comparisons of mating practices between species.

CONCLUSIONS: To wrap up this activity students can answer the following questions as a group.

1. Why do different species of butterflies have different patterns of mating?
2. Are any of these mating rituals more efficient than others? Why do you think so?
3. What are some of the environmental forces that play a role in butterfly reproduction? How important are they relative to each other?

Butterfly Reproduction Worksheet

Name:

Date:

Directions: Answer the following questions based on information you gather from the Mating section and Species Index in the Butterflies of the World ZooGuide and other references.

1. How does the male attract the female in this species?
2. How long do the male and female engage in sexual intercourse?
3. How many eggs does the female typically lay?
4. On what types of plants does the female prefer to lay her eggs?
5. Describe the courtship ritual used by this species.
6. Does wing coloration play a role in the mating ritual of this species?
If so, what role?
7. How long do the adults live after mating?
8. At what time of year do members of this species mate? Why?

7-12 Activity 5:

TOPIC: Metamorphosis

SOURCES: 'Metamorphosis' subtopic in Life Cycle chapter in Butterflies of the World ZooGuide
Species Index in Butterflies of the World ZooGuide
References listed in the ZooGuide and at the end of this guide
Your Biology textbook

ACTIVITY: In this activity students will describe in detail the process which transforms a caterpillar into a butterfly. Use this activity when studying Life Cycles, Insects, or Metamorphosis.

A caterpillar body and a butterfly body are very different in appearance. Ask your students to make a list of these differences. Save the list to refer to later. You may want to use diagrams of a caterpillar and a butterfly to help students come up with their list.

Now that you have a list of the types of changes that occur between the caterpillar and butterfly stage of life, you can explore how it happens. Use the Metamorphosis section of the Life Cycle chapter in the ZooGuide as a starting point. Students can choose a species of butterfly listed in the ZooGuide on which to focus their research. Use the references listed in the ZooGuide and this guide to find more specific information about the caterpillar to butterfly transformation. To aid their research, brainstorm questions students should try to answer. Some sample questions are given below that you can use as a place to begin.

1. What happens to the caterpillar's mouth parts?
2. How long does it take this species to metamorphose?
3. How do the antennae develop?
4. How do the wings develop?

Students or student groups can present their findings to the class in a presentation using visual aids to show the metamorphosis process.

CONCLUSIONS: Discuss the following questions to conclude this activity.

1. Do all butterfly species metamorphose in the same way? Why or why not?
2. Name two other groups of insects that undergo similar metamorphosis.
3. Why is the caterpillar stage of the life cycle so important to butterfly survival?

7-12 Activity 6:

TOPIC: Anatomy and Physiology of Butterflies

SOURCES: 'Internal Structure' subtopic in Body Plan chapter in Butterflies of the World ZooGuide
References listed in the ZooGuide and this teacher's guide
Your Biology textbook

ACTIVITY: In this activity students will recognize the internal structures that make up the anatomy of a butterfly. In addition, they will describe the physiology of major organ systems.

Use this activity when studying Insects, Anatomy, or Physiology.

Begin this activity by asking students to read and watch the information presented in the Internal Structure section of the Body Plan chapter in the ZooGuide. It presents specific information about the major internal systems and their functions.

Hand out a black line drawing of a caterpillar and butterfly body showing internal structures unlabeled. Ask students to label the various parts using the information provided in the ZooGuide, references listed, or their Biology textbook. Once the drawings are labeled, students can color the related parts (e.g., the digestive system, the circulatory system, and the reproductive system, etc.).

Now that students have labeled the parts of the butterfly and caterpillar, they can write brief descriptions of what each system or subsystem does. These physiological functions can then be compared to those of other insects such as grasshoppers, ants, bees, etc.

CONCLUSIONS: Your class may have dissected an insect to learn more about its anatomy and physiology. If so, you can compare butterfly internal structure with that of other insects you have seen.

Your students can discuss the following questions to wrap up this activity.

1. Why don't butterflies and other insects have lungs?
2. How are butterflies similar and different in anatomy compared with a non-flying insect?
3. Could a human survive with the kind of circulatory and respiratory systems that insects have? Why not?

7-12 Activity 7:

TOPIC: Butterfly Senses

SOURCES: 'Sense and Smell' subtopic in Body Plan chapter in Butterflies of the World ZooGuide
References listed in the ZooGuide and at the end of this guide
Your Biology textbook

ACTIVITY: In this activity students will identify the anatomical structures butterflies use to sense their world and compare them to other insect senses and human senses.

Use this activity with studies of Senses, Insects, Anatomy, or Physiology.

Begin this activity by asking your students to list the five human senses and the organs responsible for their function. Save this list for later comparison with one you make for butterflies.

Read and watch the information presented in the Sense and Smell section of the Body Plan chapter in the ZooGuide to gather information on the types of senses butterflies have and what anatomical structures are responsible for their function. Students should make a list of these senses and sense organs to compare with human ones.

Their list should include:

1. Compound eyes for sight
2. Antennae for touch, smell and spatial orientation (Johnston's organs)
3. Feet and legs for taste

To compare the butterfly senses and human senses students can answer the following questions.

1. How do human and butterfly senses differ?
2. What are the advantages of a compound eye?
3. What human sense do butterflies seem to lack? Why?

Now students can use references or their biology textbook to find information on insect senses in general.

1. What senses do most or all insects have?
2. Are they similar to butterfly senses?
3. Why do most insects have compound eyes?

CONCLUSIONS: Insects and specifically butterflies evolved long before humans. Their sense organs are very different as your comparisons have shown. Students can debate whether or not they are better, worse, or simply serve their specific function to the best of their ability once you have finished this activity.

7-12 Activity 8:

TOPIC: Migration vs. Hibernation

SOURCES: 'Climate' subtopic in Ecology chapter in Butterflies of the World ZooGuide
'Migration' subtopic in Ecology chapter in Butterflies of the World ZooGuide
References listed in the ZooGuide and at the end of this guide
Your Biology textbook

ACTIVITY: In this activity students will define migration and hibernation and explore these survival strategies as evolutionary answers to the same problem.

Use this activity when studying Evolution, Migration, Ecology, or Insects.

Begin this activity by asking your students to define and give examples of migration and hibernation among different organisms. Their list could include bats, rats, frogs, bees, and hummingbirds as hibernators and robins, swallows, monarch butterflies, and elephants as migrators.

Discuss the reasons why animals hibernate or migrate. Specifically, discuss butterflies and the reasons why they either migrate or hibernate.

Answer the following questions based on information you find in the Climate and Migration sections of the Ecology chapter in the ZooGuide.

1. What kinds of butterflies hibernate?
2. Name two types of butterflies that migrate.
3. Why do butterflies hibernate?
4. Why do butterflies migrate?
5. When in their life cycle can butterflies hibernate?

CONCLUSIONS: Discuss students' answers to these questions clearing up any misconceptions as you proceed. Then discuss the following open ended questions as a group.

1. Which evolutionary "trick" is better, migration or hibernation? Support your answer with information on energy requirements etc.
2. Why don't tropical species of butterflies have to worry about hibernating or migrating?

Migration vs. Hibernation Worksheet

Name:

Date:

Directions: Use the information provided in the Climate and Migration sections of the Butterflies of the World ZooGuide to answer the following questions.

1. What kinds of butterflies hibernate?
2. Name two types of butterflies that migrate.
3. Why do butterflies hibernate?
4. Why do butterflies migrate?
5. When in their life cycle can butterflies hibernate?

7-12 Activity 9:

TOPIC: Mimicry and Other Self-Defense

SOURCES: 'Self Defense' subtopic in Ecology chapter in Butterflies of the World ZooGuide
References listed in the ZooGuide and at the end of this guide
Your Biology textbook

ACTIVITY: In this activity students will describe several strategies that butterflies use to avoid predation in the wild.

Use this activity when studying Evolution, Ecology, Adaptations, or Insects.

Begin this activity by asking your students what general types of "weapons" animals and plants use to avoid predation. Their list could include camouflage, warning coloration (bright colors that announce an organism is poisonous), cryptic coloration, defensive secretions, mimicry, and ambiguity of body orientation. Butterflies and butterfly caterpillars display many of these adaptations for defensive purposes.

Students can gather information on the types of self defense butterflies and caterpillars use by reading and watching the information presented in the Self Defense section of the Ecology chapter in the ZooGuide and other references listed. They can answer the following questions to show their comprehension of the material provided.

1. What method of protection do heliconids use? (They are poisonous and advertise this fact with brightly colored wings.)
2. Describe 3 ways that caterpillars protect themselves. (They camouflage themselves to look like bird droppings, are colored to blend in with their surroundings, or they hide in leaves or webs.)
3. How do butterflies protect their eggs? (They deposit them on the undersides of leaves to hide them from predators.)

Divide the class into several groups, each of which will be assigned a different kind of self defense mechanism used by butterflies. They will create a multi-media presentation on this mechanism to present to the class. They can use pictures from the ZooGuide, references, or their biology textbook and should find examples in nature if the season permits. They should present their data in a dynamic and creative way that engages the rest of the class in discussion afterward.

CONCLUSIONS: After students have given their presentations the whole class can gather to discuss the following questions about self defense.

1. Why do many poisonous butterfly species look very similar?
2. What is the advantage of advertising to potential predators that you are poisonous?
3. How do butterflies use eyespots to protect themselves?

7-12 Activity 10:

TOPIC: Parasitism of Caterpillars

SOURCES: 'Parasites' subtopic in Ecology chapter in Butterflies of the World ZooGuide
References listed in the ZooGuide and at the end of this guide
Your Biology textbook

ACTIVITY: In this activity students will explore the evolutionary causes of parasitism in the case of wasps and caterpillars.

Use this activity when studying Evolution, Adaptation, Parasitism, or Insects.

Begin this activity by defining parasitism in animals. Ask your students to list several examples of parasitic relationships in nature.

1. What parasites live on human hosts?
2. What are the advantages to parasitism?
3. What, if anything, are the disadvantages of parasitism to the parasite?

Now that your students have begun thinking about parasitism in a general sense, they can focus on the specific situation of wasps and caterpillars. Read and watch the information presented in the Parasites section of the Ecology chapter in the ZooGuide to learn more about this phenomenon.

Working in groups, students should develop plausible evolutionary stages for the wasp/caterpillar relationship to have developed over time. They can address the following issues and questions as they create their sequence of events.

1. Why did wasps choose caterpillars to parasitize?
2. What would early ancestors of these parasites have likely done to get nutrients from caterpillars?
3. Have caterpillars developed any mechanisms in response to this parasitism? What are they?
4. Describe the range of possible types of wasp parasitism from outright killing of the caterpillar to keeping it alive for as long as possible.

CONCLUSIONS: Students can present their hypotheses to the class for discussion and debate. They can help each other to hone their skills at research and theorizing about evolutionary predecessors in the parasite process.

7-12 Activity 11:

TOPIC: Classifying Butterflies

SOURCES: Species Chapter in Butterflies of the World ZooGuide
Species Index in Butterflies of the World ZooGuide
References listed in the ZooGuide and at the end of this guide
Your Biology textbook
Latin-English Dictionary

ACTIVITY: In this activity students will learn about the scientific classification system and how butterflies are named based on physical characteristics.

Use this activity in conjunction with studies of Classification or Insects.

Students should begin by reading and watching the information presented in the Species chapter. It offers data on the naming procedure, how butterflies are classified, and the controversy over the number of families into which scientists divide butterflies. Once they have read and absorbed this information, students can apply it to a study of the 15 families presented in the Species Index of the ZooGuide. Their task is to find out the following information on at least three families present.

1. The English translation of the Latin names (Family, Genus, and species)
2. The common characteristics that scientists use to group species of these families together.
3. The role played by the butterflies' environments in the classification scheme.

When students have gathered this information, they can present their findings to the class. The whole group can then construct a classification "tree" for butterflies based on their data and in this way they can become more familiar with the scientific classification system.

CONCLUSIONS: Students can conclude this activity by discussing the following questions.

1. Why is it difficult for all scientists to agree on a single classification system?
2. What are some of the challenges that scientists face when trying to establish a classification system?
3. What have you learned from doing this activity?

7-12 Activity 12:

TOPIC: Classification Part 2

SOURCES: Species Chapter in Butterflies of the World ZooGuide
Species Index in Butterflies of the World ZooGuide
References listed in the ZooGuide and at the end of this guide

ACTIVITY: In this activity students will debate the pros and cons of grouping Hesperidae with butterflies versus moths. This will require them to divide into two groups and gather information to support their side of the argument.

Begin by reading the information provided in the Species chapter on classifying butterflies and continue by looking at the information in the Hesperidae chapter. There are bits of data here that indicate some of the controversy about grouping the Skippers with butterflies. Use this to continue your research in references listed in the ZooGuide and this guide.

Student groups should prepare to debate their side of the argument with supporting information from the various resources listed above. Their arguments should be clear, concise, and scientific.

Once your students have had time to do their research they can begin their debate. You may want to act as moderator or choose a panel of students to serve this purpose. At the end of the debate you or the student panel can decide, based on the evidence, where Hesperidae should be grouped and why.

CONCLUSIONS: Wrap up this activity with a discussion of the following questions.

1. Why is debate and peer review a good way for scientists to challenge their own ideas?
2. Which side won the debate?
3. What swayed the judge(s), the facts of the case or the way they were presented?

7-12 Activity 13:

TOPIC: Butterfly Family Research

SOURCES: Species chapter in Butterflies of the World ZooGuide
Species Index in Butterflies of the World ZooGuide
References listed in the ZooGuide and at the end of this guide
Your Biology textbook

ACTIVITY: In this activity students will write a research paper on one of the 15 families of butterflies listed in the Species Index of the ZooGuide. They can work in groups or alone and can be assigned a family to research or they can choose, as long as all 15 are represented in the class.

The following are a list of suggested data that students can gather for their research. Add to or delete from this list as you see fit.

1. Number of species in this family.
2. Range of sizes of members of this family.
3. Where they live.
4. What types of plants they eat.
5. What defenses they have against predators.
6. Include a drawing or photograph of representative members of the family.
7. Characteristics scientists use to group members of this family. (eg., antenna shape, wing coloration, body shape, feeding habits, etc.)
8. When in their life cycle the butterflies hibernate, if at all.
9. Life span — How long are they a caterpillar, a pupae, a butterfly?

Students or student groups should combine the information they gather on the above topics into a well formed essay to be presented to the class or kept with the ZooGuide for future classes to use in their research.

CONCLUSIONS: To conclude the above activity, gather your students and discuss the following questions.

1. Which family of butterflies do you think is the most diverse? Why?
2. What did you learn about butterflies that you didn't know before you wrote this paper?
3. Add one question to the list above for future classes to include in their research papers.

7-12 Activity 14:

TOPIC: Butterfly Gardens

SOURCE: **RESOURCES** Resources section of the Butterflies of the World ZooGuide

ACTIVITY: In this activity students will visit a butterfly garden or zoo in your local area to learn more about their habitats and see butterflies first hand. Use this activity with studies of Ecology, Habitat, Life Cycles or Insects.

Begin this activity by finding a butterfly garden near you using the Resources button in the ZooGuide. It is located in the lower left corner of the main screen. Click on the button and a list of reference books, butterfly gardens, and other CD ROM titles appears. Scroll down to US butterfly gardens or those listed for your country and look for one in your state or a city near your school. If there isn't a butterfly garden listed that is near your school, check with your local zoo and see if they have a butterfly exhibit.

Now that you have located a garden or zoo to see live butterflies at, you can plan a field trip for your class. They can visit the butterfly garden with the considerable knowledge about butterflies that they have learned from doing previous activities in this guide. Students should bring drawing paper with them to the garden or zoo so they can record what they see. If you have access to a camera, bring it as well to take pictures of the various butterflies and habitats displayed.

When you return to the classroom from your field trip, you and your students can construct a bulletin board showing all that you learned on your trip to the butterfly garden. Use photographs, drawings, and any notes you took to recreate the atmosphere of the garden on your bulletin board. Use construction paper to make grass, flowers, and trees. Cut out pictures of butterflies from photographs, drawings students made, or from the ZooGuide to paste onto your butterfly habitat. Try to make the scene as authentic as possible. Include butterflies in various stages of life such as eggs, caterpillars, chrysalises, and adults. Finally, label the parts of your scene with names of plants, butterflies, and anything else you have included.

CONCLUSIONS: Discuss the following open ended questions once you have completed the bulletin board.

1. What did you learn that you didn't already know from visiting the butterfly garden?
2. Why are butterfly gardens important?
3. What else would you like to learn about butterflies now that you have studied the Butterflies of the World ZooGuide?

7-12 Activity 15:

TOPIC: Adding to the ZooGuide

SOURCES: References listed in the ZooGuide and this guide
Your Biology textbook

ACTIVITY: In this activity students will make additional chapters or chapter sections to add to the ZooGuide and make it a more comprehensive reference.

Use this activity when studying any of the topics listed in previous activities.

Begin by skimming the ZooGuide looking for places where you feel more information is needed to make it more complete. For example, you could add a section to the Body Plan chapter which explores the antennae in more detail.

Once students have chosen an area that they want to add to, they should conduct research to find facts to include in their written materials and look for interesting and attention grabbing pictures or footage of butterflies which demonstrate their data. The written data should be concise but clear and the pictures should be easy to see.

Students can create their own multimedia supplement to the ZooGuide if your school has access to an appropriate software package such as MacroMind Director™. If software of this type is not available then keep the data your students create in a notebook for future classes to use when studying insects or the ZooGuide.

CONCLUSIONS: To conclude this activity and all the activities associated with the Butterflies of the World ZooGuide your students can discuss the following questions.

1. What major biological concepts have you learned using the ZooGuide?
2. Do you feel that the ZooGuide is more or less dynamic than a book? Why or why not?
3. What other ideas for activities can you create with which to use the ZooGuide?

References:

The references listed in this section are divided into two parts: K-6 activity references, and 7-12 activity references. In addition, there are references in the ZooGuide you can access by clicking on the Resources button located in the lower left corner of the main screen. The references listed here were found in a local public library and represent a small portion of the books that are available on this topic. If you cannot find a specific reference listed below, try to find a book with similar content in your school or local library.

K-6 Activity References

Bailey, D., *Amazing Butterflies and Moths*, Austin, TX: Steck-Vaughn, 1990.

Fichter, G.S., *Butterflies and Moths*, New York: Golden Press, 1993.

Fischer-Nagel, H., *Life of the Butterfly*, Minneapolis: Carolrhoda Books, 1987.

Florian, D., *Discovering Butterflies*, New York: Scribner, 1986.

Herberman, E., *The Great Butterfly Hunt: the mystery of the migrating Monarchs*, New York: Simon and Schuster Books for Young Readers, 1990.

Mitchell, R.T., *Butterflies and Moths: a guide to the more common American species*, New York: Golden Press, 1991.

Norsgaard, E.J., *How to Raise Butterflies*, New York: Dodd, Mead, 1988.

Rowen, J.P., *Butterflies and Moths*, Chicago: Children's Press, 1983.

Ryder, J., *Where Butterflies Grow*, New York: Lodestar Books, 1989.

Still, J., *Amazing Butterflies and Moths*, New York: A.A. Knopf, 1991.

Watts, B., *Butterfly and Caterpillar*, Morristown, NJ: Silver Burdett Co., 1986.

Whalley, P.E.S., *The Butterfly in the Garden*, Milwaukee: G. Stevens Publishing, 1987.

7-12 Activity References:

Brackenbury, J., *Insects in Flight*, London: Blandford, 1992.

Brackenbury, J., *Insects: Life Cycles and the Seasons*, London: Blandford, 1994.

Parenti, U., *The World of Butterflies and Moths*, New York: Putnam, 1978.

Pretty Poison (video) Greene and Dewar New Wilderness Productions, Los Angeles, CA: Prism Entertainment, 1987.

Smart, P., *The Illustrated Encyclopedia of the Butterfly World*, New York: Crescent Books, 1989.

The Swarming Hordes (video), The BBC in association with Warner Brothers and Reiner Moretz Prod., John D. and Catherine T. MacArthur Foundation Library Video Classics Project, 1988.