

# An Educator's Guide to *Butterflies!*

Lessons and Other Resources for Teachers



Supported by funding from the National Science Foundation

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## Lessons and Other Resources for Teachers

### *Introduction*

These materials were developed by The Academy of Natural Sciences in conjunction with Philadelphia school teachers. The subject matter was designed to complement the Academy's live *Butterflies!* exhibit, but a visit to the Academy is not required. Each lesson included is classroom-based. Lessons are aligned with both Pennsylvania State and Philadelphia District standards and address multiple curriculum content areas, including Math, Science, Literacy, Geography, Visual Arts, and Technology Education.

### *How to Use This Guide*

This guide contains twelve lessons, each with associated pre- and post-lesson exercises, designed for students in grades five through eight. General background information, a glossary of vocabulary terms, and content standards descriptors are also provided. The topic of each lesson falls under one of three major themes: Life Cycles, Habitats, or Adaptations. Each lesson is designed as an independent "stand-alone" and does not need to be taught in sequence with the other lessons. Teachers may choose to utilize the entire guide or only those lessons and activities that they consider most applicable to their students' needs. Two of the four lessons in each thematic unit include optional Academy-based components involving activities to do while in the *Butterflies!* exhibit. Although a museum visit will enhance the students' experience and comprehension, all lessons can be completed without these elements.

### Specific components of each lesson include:

1. **Introductory Pieces:** Journal Prompts (to build student background knowledge and access prior knowledge), a Word Bank (with vocabulary linked to the accompanying glossary), and Objectives (identifying goals that can be measured).
2. **Procedure:** Step-by-step directions for the teacher on how to set up materials, conduct the lesson, and assess student performance successfully.
3. **Reflection Pieces:** Concluding activities providing opportunities for students to process new knowledge.
4. **Extension Activities:** Suggested for higher-level students, or for teachers who would like their class to follow-up and build on new concepts. Includes *Take-It-Back* strategies that encourage reciprocal teaching (students who participate in the lessons become "experts," turning the new knowledge around to other classes).
5. **Parent-Links:** Home-based activities related to the lesson content.
6. **Multi-disciplinary Connections:** Exercises that target Pennsylvania State Standards and Philadelphia District Standards in areas other than just science.
7. **Museum Components (for some lessons only):** Linked activities to be done at the Academy's *Butterflies!* exhibit.

## Credits

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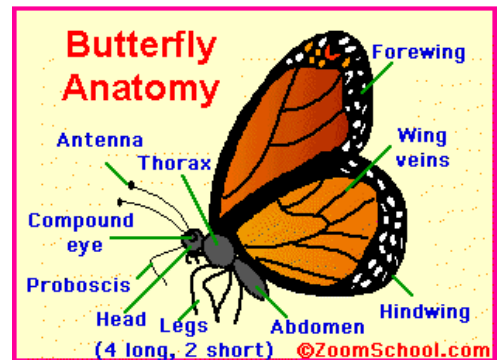
# General Introduction: Butterflies

## What are butterflies?

Butterflies and moths are insects that make up the order Lepidoptera, derived from the Greek words *lepidos* for scaly and *ptera* for wings. They are distinguished from all other insects by the scales that cover their bodies. Each scale is just a single color. The beautiful designs on butterfly and moth wings are produced by thousands of individually-colored scales overlapping one another. The wings themselves are actually transparent. When these insects are handled, their scales may rub off. This looks like colored powder on your skin. Butterflies and moths have four wings - two forewings and two hindwings.

## What are butterflies related to?

Insects are members of the invertebrate phylum Arthropoda, along with centipedes, millipedes, crustaceans, horseshoe crabs, spiders, and ticks. Arthropods are animals without bones that have jointed limbs and a tough outer covering - an exoskeleton - made of chitin. Insects are arthropods that, as adults, possess the following characteristics: three body parts (head, thorax, abdomen), six legs, two antennae, two compound eyes, and, with a very few exceptions, wings. Other types of insects include bees, beetles, dragonflies, grasshoppers, ants, cockroaches, and flies.



## What is the difference between butterflies and moths?

There is no absolute answer to this question, because the distinction between these groups is largely artificial. When most people use the word “butterflies”, they tend to be referring to *any* Lepidoptera that are diurnal (that fly during the daytime). However, this lumps together “skippers” and “true butterflies”, groups that are, in fact, scientifically discrete. Furthermore, all these groups are really just specialized types of moths. However, some differences apply more often than not:

- While many moths fly at night, no butterflies are nocturnal. They are active only during the day or at dawn and dusk. Butterflies are often more brightly colored because, in the daylight, they rely more heavily on visual signals for communication. Moths that fly during the day are therefore also brightly colored. (Skippers, on the other hand, are quite drab even though they are diurnal.)
- Butterfly antennae tend to be thickened or have knobs at the tips (skippers have distinctly bent tips). Moth antennae are much more varied in appearance; most often, they are feathery or straight and threadlike. Many moths have more prominent antennae than butterflies because, in the dark, they rely more heavily on smell for communication.
- When not flying, butterflies usually rest with their wings partially open or held together upright. Moths tend to rest with wings wide open or folded tent-like over their bodies.
- Moths often have a thicker coating of scales than butterflies, giving them a furry appearance.

## **How many butterflies are there?**

Butterflies and moths are most numerous in the tropics, but they live on every continent except Antarctica. They are found in almost every type of habitat except oceans and land permanently covered in snow. Some Pyralid moths even live under water as caterpillars. Scientists have described around 175,000 species of Lepidoptera worldwide, of which about 15,000-20,000 species are “butterflies” (including skippers). There are believed to be hundreds of thousands of lepidopteran species still to be named or discovered. More than 80% of all Lepidoptera are moths. Of the identified species, 750-800 “butterflies” and around 11,000 moths have been found in the United States and Canada. More than 100 species of “butterflies” can be seen in the Delaware Valley and vicinity.

## **What do butterflies eat?**

Caterpillars are very particular about the plants they eat. An adult female butterfly will lay her eggs on specific plants, so that when her larvae hatch they will be on the correct food source. For example, the monarch butterfly will only lay her eggs on milkweed plants. Otherwise, the caterpillars will starve. Such larval food plants are known as host plants. Larvae store up the energy they will need to change into an adult by feeding voraciously on their host plants with their powerful, chewing mandibles (jaws). Adult butterflies, instead, have mouth parts that only drink fluids. They have a coiled proboscis, which unrolls into a straw-like tube that in some species may be longer than the butterfly’s body. Adult butterflies feed on flower nectar, as well as sipping from rotten fruit, sap, dung, or muddy puddles. Butterflies get all their moisture from their food – they do not drink from open bodies of water.

## **What is the difference between male and female butterflies?**

The abdomen (the third body segment) is larger and rounder in females than males. Females also have two openings in their abdomens, while males have only one. While not always visible, all females have an ovipositor, or egg-laying device; males do not. Additional ways to distinguish between genders exist in different species. Many species are sexually dimorphic, meaning the males and females look different (in coloration, pattern, size, etc.). Males and females may also display different behaviors in certain species.

## **Why are butterflies important?**

Butterflies provide people with beauty and enjoyment, but they are also important ecologically. Eggs, larvae, pupae, and adult butterflies are all vital links in the food chain, providing meals for a variety of birds, small mammals, reptiles, amphibians, and other animals. Caterpillars help recycle nutrients in the environment, and adult butterflies help pollinate many flowering plants. Because butterflies are very sensitive to changes in their surroundings, they are also important “indicator species”, detecting environmental changes before people might otherwise become aware of them. A shift in butterfly numbers or species composition in a particular area can signal significant alteration of a habitat’s quality. Unfortunately, many butterfly species around the world are in decline, and others have already gone extinct. The biggest overall threat to them is habitat loss. Deforestation, agriculture, urbanization, introduced non-native species, global climate change, and pollution are just some of the factors contributing to the degradation or destruction of butterfly habitat(s).

## **What can be done to help butterflies?**

The best way to ensure butterfly survival is by maintaining suitable, healthy habitat. Leave natural habitats as they are, and support groups working to restore wild lands. Avoid using pesticides, herbicides, or chemical fertilizers around your homes, and try to minimize your contributions to other types of pollution. For instance, conserve energy whenever possible, in order to reduce carbon dioxide emissions. Create habitat by planting a butterfly garden that provides nectar plants for adult butterflies, host plants for eggs and larvae, and both sunny and sheltered spots. Remove invasive, non-native plant species and grow native species instead.

You can also learn how to tag butterflies to help scientists study migration and other behavior, or simply become educated about butterfly issues. Contact your state office or visit some of the sites below to learn about local conservation efforts or to gather general butterfly information.

**The Nature Conservancy:** <http://www.nature.org/>

**The Butterfly Conservation Initiative:** <http://www.butterflyrecovery.org/>

**North American Butterfly Association:** <http://www.naba.org/>

**The Lepidopterists' Society:** <http://www.lepsoc.org/>

**The Xerces Society:** <http://www.xerces.org/>

**MonarchWatch:** <http://www.monarchwatch.org/>

# Introduction: The butterfly life cycle

## Metamorphosis

Butterflies undergo metamorphosis, a process of dramatic change in body form during their lives. Specifically, they experience complete metamorphosis, characterized by four distinct stages: egg, larva (caterpillar), pupa (chrysalis), and adult (butterfly). The life cycle begins with a female butterfly laying eggs on a host plant, the only food that her caterpillars will eat. Different species rely on different host plants. For instance, Red Admiral larvae eat nettles, while Black Swallowtail caterpillars rely on carrot plants. Eggs may be deposited in large clusters or laid singly, depending on species. A female may lay hundreds or even thousands of eggs in her lifetime, but as few as 2% will likely make it to adulthood.

Most eggs hatch within a few days, to reveal a tiny caterpillar. Once out of the egg, the larva eats almost constantly. It eats its egg shell first and then feeds on the host plant. Caterpillars can grow many thousands of times their original size before pupating. Since they have a rigid exoskeleton, they must molt, or shed their skin, as they continue to grow. Butterfly caterpillars typically molt four or five times. The larval stage can last from around ten days to two years, depending on the species and on whether development is interrupted by winter seasons. Before their final molt, caterpillars spin a silk pad from which to attach themselves to a twig or other surface; they then molt into the pupa. Silk is produced in the salivary glands and spun with special mouth parts called spinnerets. Some moth larvae also spin a protective cover, called a cocoon, for their pupae to transform within. Some cocoons incorporate leaves or soil; others are made of just silk. Butterflies do not make cocoons; the butterfly pupa is called a chrysalis.

Pupae are not mobile (although they can wiggle around) and do not eat or grow, but within the pupa, there is much activity. Larval structures break down and are reorganized as adult body parts develop. The pupal stage may last from a few days to a few months, depending on species, after which the winged adult emerges. Some adult butterflies live less than a week, while a few can live for almost a year. The life span again depends on the individual species, as well as on environmental factors. *Most* adult butterflies live for about a month.

## Surviving the winter

Butterflies that live in habitats that do not regularly experience cold periods will die if exposed to freezing temperatures. Species that reside in seasonal environments are adapted to face the challenge of winter. Many butterflies survive the cold weather by entering diapause, an interruption in their development that is similar to hibernation. This is a dormant period during which no growth or change occurs. Most butterflies that spend the winter in diapause do so in the larval or pupal stage; some species overwinter as eggs. The dormant insects hide in natural cavities or under bark, soil, or leaf litter, and even in undisturbed spots in unheated buildings. A small number of species hibernate in adult form, such as Mourning Cloaks and some Comma butterflies. Adult butterflies from other species survive the winter instead by migrating to warmer climates, then returning home in the spring. Monarch butterflies and Painted Ladies are examples of migratory species. The stage of the life cycle that undergoes diapause or migration can live significantly longer than an egg, larva, pupa, or adult of the same species living during warm weather or in a non-seasonal environment.

## **Introduction: Adaptations**

An adaptation is any physical or behavioral trait that helps an organism survive. One important butterfly adaptation is flight. Wings enable adult butterflies to seek out mates and locate food plants. Coloration is another adaptation. Different colors and patterns help butterflies communicate, defend themselves, and control their body temperature. Dark colors, for instance, help these cold-blooded animals absorb the sun's heat. Some of a butterfly's most important adaptations are those that help it to sense its world and protect itself from predators.

### **Senses**

Butterflies use their senses to help them find food and mates, to locate places to lay their eggs, to avoid danger, and to move from place to place. Butterflies perceive the world quite differently than humans do. Although we have some senses in common, they may not be used in exactly the same way. Butterflies also detect things that we cannot, such as polarized light. They may even have senses of which we are unaware, since we can only understand the world through the bias of our own five senses. Their most important senses are sight and smell/taste, and butterflies communicate mainly through visual and chemical signals.

Compound eyes record multiple images and detect both movement and color easily; butterflies see colors in both the visible and the ultraviolet spectrum. Antennae are used for smelling and are highly sensitive to plant scents and pheromones (chemicals produced by butterflies to attract the opposite sex). Taste sensors on legs and feet respond to the presence of nectar and also help females find the right plant on which to lay eggs. The sense of touch comes from sensory hairs called setae that are scattered across the body. To the extent that butterflies perceive sound at all, they do so mostly by feeling vibrations with these tactile setae. A very few species have a simple structure like an eardrum that can pick up certain sounds.

### **Defenses**

Butterflies face many predators throughout their life cycle and protect themselves with both behavioral and physical adaptations. Many species lay hundreds, or even thousands, of eggs as a way to ensure that at least some offspring survive. Some caterpillars and adults startle or frighten predators by, respectively, rearing up suddenly or flashing brightly-patterned wings unexpectedly. Adults can also fly away from danger. While some species can move rather fast, most butterflies that use this defense evade capture instead by flying in an erratic pattern.

Physical defenses include camouflage, warning coloration, mimicry, and noxious smells or tastes. Many eggs, larvae, pupae, and adults use color to blend in with their surroundings. Some camouflage extends beyond color to include form. For instance, certain butterflies are shaped like dead leaves, and the caterpillars of various Swallowtail butterflies look like bird droppings. Many caterpillars and adults have eyespots or other deceptive markings. For instance, the Owl butterfly might be mistaken for an actual owl, deterring a predator. Some caterpillars have stinging spines or give off smelly chemicals when touched. Other caterpillars and adult butterflies are poisonous; they get their toxins from the host plants they eat as larvae.

Poisonous species tend to advertise their presence with bright colors to warn predators not to eat them. Other butterflies mimic this bold coloration to discourage predators as well. These mimics may or may not be poisonous themselves. For instance, the Monarch butterfly and the Pipevine Swallowtail are toxic species. Viceroy butterflies have patterns like Monarchs, and some female Black Swallowtails mimic Pipevines. A predator that has eaten a Monarch or Pipevine and become sick will avoid eating these species, as well as their mimics, in the future. However, whereas the Viceroy is truly toxic, the Black Swallowtail is actually a harmless, tasty mimic.



# **Introduction: Habitats and Conservation**

## **Habitat components**

Like all animals, butterflies rely on their habitats to provide them with water, food, shelter, and enough space to encompass all these things. Larval and adult butterflies obtain all their moisture from their food and do not need open water sources from which to drink. Larvae mostly feed on leaves and stems from specific plants, called host plants. Caterpillars from different species rely on different host plants. Food for adult butterflies is mostly nectar from flowering plants, although certain species depend more on sap. They also obtain various minerals by drinking from carrion, fruit, dung, and mud. Adult butterflies need both nectar and host plants in their habitats, because most species will only lay their eggs on host plants to ensure that their larvae will not starve. Butterflies also need shelter. They are rather delicate and need trees, shrubs, dead logs, or other enclosed areas to protect them from wind, rain, and predators. They are also cold-blooded and need resting areas exposed both to the sun and to the shade so that they can stay warm or cool down as needed.

## **The value of butterflies**

Habitats rely on butterflies, too. Adult butterflies help plants reproduce by transferring pollen grains as they fly from one flower to the next to feed on nectar. They are one of the most important groups of insect pollinators - after bees, flies, and beetles – and may be responsible for pollinating as many as 10% of all flowering plants. Caterpillars recycle nutrients by chewing and digesting enormous quantities of plant material and then depositing their waste (called frass). The frass returns the nutrients to the environment, where they become available for other plants and animals to use. Eggs, caterpillars, pupae, and adult butterflies are all nutritious food sources for birds, reptiles, amphibians, and other animals. Butterflies are also important “indicator species”, organisms that are particularly sensitive to habitat change and thus can alert people to environmental problems.

## **Threats to butterflies**

Habitat loss or degradation is the greatest threat to butterfly survival worldwide. As natural areas are deforested, mined, or broken up to accommodate homes, farms, roads, stores, they can no longer support the plants which feed and shelter butterflies. Non-native plants and animals that people have introduced into natural areas compete with the native plants that butterflies need or kill butterflies directly. Butterflies are also very sensitive to pollution, and the use of herbicides, pesticides, and other chemicals in parks and gardens kills them. Global warming is likely to have a strong impact on butterfly populations as well, as the geographic distribution of plant species and habitats shifts with changing climate.

Around 35 species of butterflies are already thought to have gone extinct in the United States alone as a result of human activity during the past century. More than 20 butterfly species and subspecies are currently listed as threatened or endangered under the federal Endangered Species Act. Additional populations are at risk within individual states. Many other species and subspecies are in danger internationally.

**Target:** 5<sup>th</sup>-8<sup>th</sup> Grade

**Duration:** One 45-minute lesson w/ extension options and parent links

**Discipline Connections:** Science, English, Visual Arts, Technology, and Geography

**Before the Lesson/ Materials:** Copies of Student Handout 1.1, Life Stages Cards 1.2, Student Handout 1.3 (optional), and Rubrics 1.1, 1.3 (optional), and 1.R for each student

**Word Bank:** Life Cycle, Metamorphosis (Complete Metamorphosis, Incomplete Metamorphosis), Egg, Larva, Pupa, Chrysalis, Cocoon, Adult (Butterfly)

**Objective:** Students will demonstrate their understanding of a life cycle. They will observe the different stages of development during complete metamorphosis in butterflies, incomplete metamorphosis in other insects, and frog metamorphosis.

**Background:** In this activity, students will learn that most insects undergo metamorphosis. Butterflies and the majority of insects undergo complete metamorphosis, other insects like grasshoppers undergo incomplete metamorphosis, and frogs, which are amphibians, undergo a gradual process of metamorphosis.

**Focusing Question:** What is a life cycle? Describe your life cycle up to this point in your life.

**Procedure:**

1. Distribute Student Handout 1.1 and Rubric 1.1.
2. Have students respond in writing to the focusing question and select a few students to share highlights from their responses.
3. State the lesson's objective and write the objective on the board.
4. Distribute Life Stages Cards 1.2 to each student.
5. Go through the life stages of each organism and have students identify each stage.
6. Have the students answer each of the questions on Handout 1.1.
7. Review types of metamorphosis and answers to Student Handout 1.1.

**Museum Activities (optional):**

8. At the Academy's *Butterflies!* exhibit, students will observe the life cycles of butterflies, grasshoppers and frogs (within the Metamorphosis tanks).
9. Distribute Student Handout 1.3 and Rubric 1.3.

**Reflection:**

Ask students to write a paragraph comparing and contrasting the three different types of metamorphosis. Have them list as many organisms as possible that undergo metamorphosis. Have several students share their paragraphs. Distribute Rubric 1.R.

**Assessment:**

Completed Student Handout 1.1, Student Handout 1.3, and Reflection Paragraph

### **Extension Options:**

- The following websites provide short video segments that explore the developmental process of metamorphosis:  
Metamorphosis: Change of Plans Video on Teachers' Domain:  
<http://www.teachersdomain.org/K-2/sci/life/cyc/metamorph/index.html>  
"The Emergence of a Monarch" at:  
<http://www.adver-net.com/Monemerg.html>
- Using the library or internet resources, have students complete a research project on an organism that undergoes metamorphosis.
- Have students pretend that they are one of the creatures they learned about in class or in their research. Have them write their life story, making certain that they mention the different stages of metamorphosis, including diet and habitat changes. They should illustrate their story with relevant images.
- Ask students, "If you had to be an organism that was studied, which one would you choose to be?" Have students support their choice with scientific facts and personal reasons.
- Have students read the book entitled The Very Hungry Caterpillar by Eric Carle (published by Philomel, ISBN 0-399-22690-7) to a lower grade and have them teach the students about metamorphosis. They may use the life stages cards as teaching tools. *Remember to point out that – despite what the book says – butterflies don't make cocoons (they make chrysalises).*

### **Parent-Links:**

- Have students observe the development of brine shrimp or mealworms.
  - a. Brine shrimp (sea monkeys) are crustaceans and are related to crabs and lobsters.
  - b. Place two or three mealworms in a capped jar. Provide the mealworms with bran and a slice of raw potato or apple. The mealworm is the larval stage of a beetle. The mealworm goes through a pupal stage that resembles neither the "worm" nor the "beetle" developmental periods.

### **Resources:**

- <http://www.Monarchwatch.org/>
- [www.amazon.com](http://www.amazon.com)
- <http://www.teachersdomain.org/K-2/sci/life/cyc/metamorph/index.html>
- <http://www.biologycorner.com/bio1/notes-arthropods.html>
- <http://www.ndsu.nodak.edu/entomology/topics/growth.htm>

### **Standards:**

***Philadelphia City Standards:*** Reading 1,3; Writing 1,2,3; Speaking 1; Listening 1; Science 1,3,5; Arts 1,7

***Pennsylvania State Standards:*** Reading, Writing, Speaking, Listening 1.1,1.2,1.4,1.5,1.6,1.8; Geography 7.4A-B; Science and Technology 3.1A and E, 3.3A-B, 3.6B, 3.7 C and E; Family and Consumer Sciences 11.2H; Art 9.1 B, I, J, and K

## Student Handout 1.1

## Life Cycles/Metamorphosis

Name: \_\_\_\_\_

Date: \_\_\_\_\_

### Focusing Question:

What is a life cycle? Describe your life cycle up to this point in your life.

Using the Life Stages Cards given in class, answer the following questions.

1. Describe at least one similarity in the life cycle of each organism:
2. Describe at least one difference in the life cycle of each organism:
3. Why do you think the developmental stages of an organism are arranged in a circle?
4. How does the development of frogs and insects differ from that of humans and other mammals like dogs, cats, and pigs?
5. Describe how the needs of butterflies change as they go through different stages of metamorphosis.

### Focusing Question:

What is a life cycle? Describe your life cycle up to this point in your life.

*Answers will vary.*

### Life Stages Cards:

Organism #1: *Butterfly*

Order of Life Cycle: *egg, larva (caterpillar), pupa (chrysalis), adult - Complete Metamorphosis, 4 distinct stages*

Organism #2: *Grasshopper*

Order of Life Cycle: *egg, larva (nymph), adult - Incomplete Metamorphosis, 3 distinct stages*

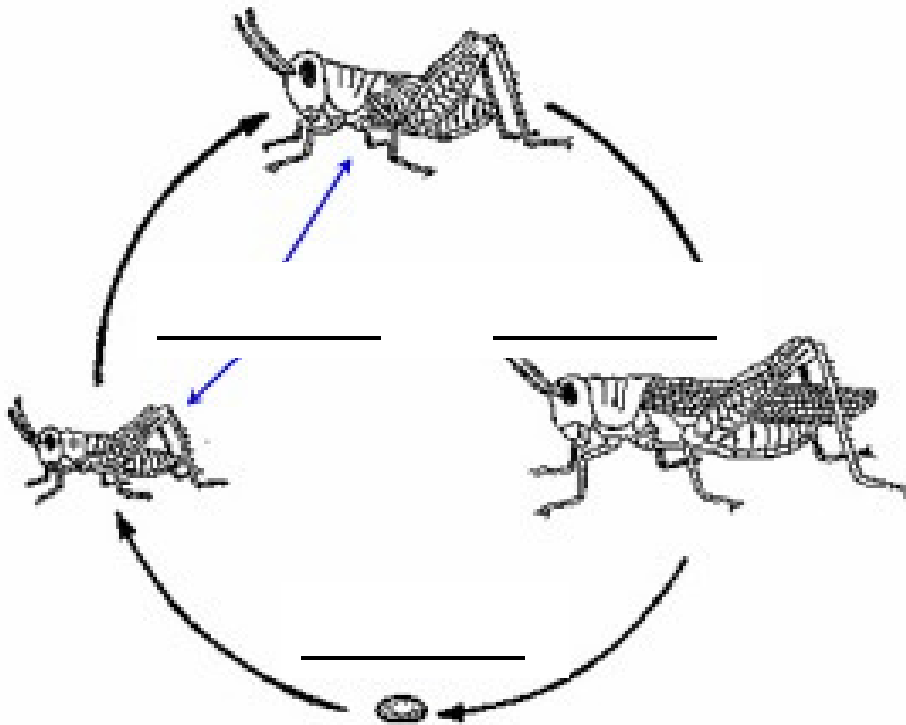
Organisms #3: *Frog*

Order of Life Cycle: *egg, larva (tadpole & froglet), adult - 3 distinct stages*

Using the Life Stages Cards given in class, answer the following questions.

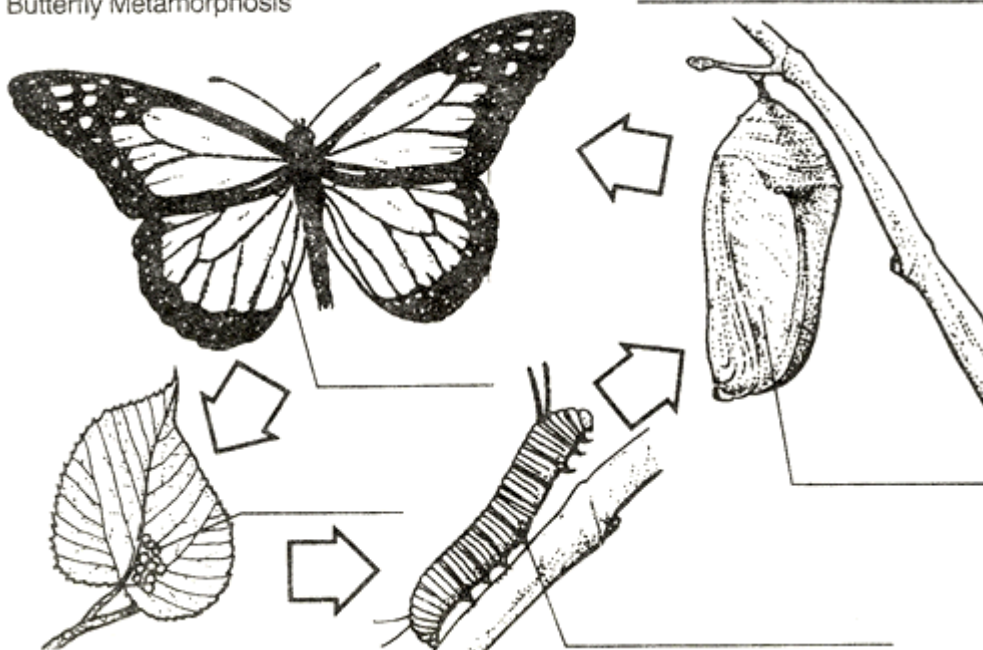
1. Describe at least one similarity in the life cycle of each organism.  
*organism gets larger at each stage, organism changes at each stage, organism is more complex at each stage, all organisms start as eggs, all adults breathe air; share any other possible answers*
2. Describe at least one difference in the life cycle of each organism.  
*organisms look different from each other at each stage; butterflies go through 4 stages, grasshoppers through 3 stages, and frogs through 3 stages; butterflies and frogs have different lifestyles (diets, habitats) as larvae and adults, but grasshoppers don't change; share other answers*
3. Why do you think the developmental stages of an organism are arranged in a circle?  
*Each stage leads to the next stage, with adults cycling back to the start by laying the eggs for the next generation.*
4. How does the development of frogs and insects differ from that of humans and other mammals like dogs, cats, and pigs?  
*Point out that frogs and insects develop new body parts (like lungs and wings) and change body shape as they mature. This process is called metamorphosis. Mammals once born primarily increase in size, proportion, and complexity, but don't develop brand-new structures.*
5. Describe how the needs of butterflies change as they go through different stages of metamorphosis.  
*All stages need to avoid getting eaten - eggs and pupae can't move away from danger so must develop other strategies (like camouflage); an egg needs to survive long enough to hatch; a larva needs a host plant to eat; a larva needs to grow a lot bigger and molt; a pupa needs to be firmly attached so that it is undisturbed while it transforms itself; an adult needs to find a mate and eat nectar from plants in order to have energy to reproduce; a female adult needs a host plant on which to lay its eggs.*

Type of Metamorphosis: \_\_\_\_\_

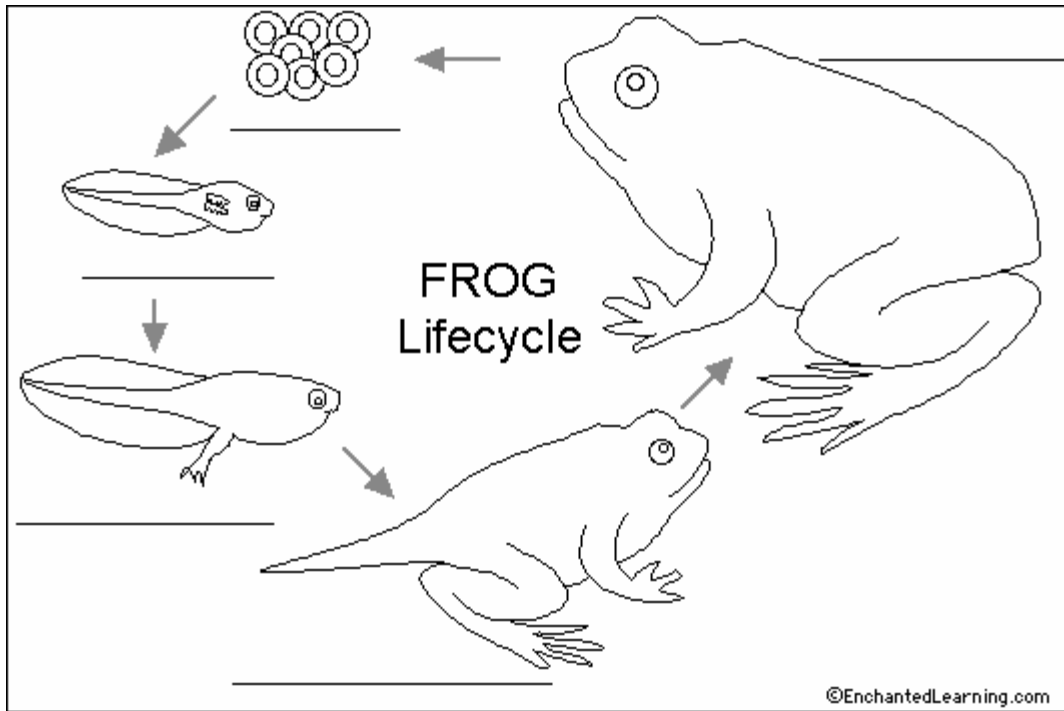


Type of Metamorphosis: \_\_\_\_\_

Butterfly Metamorphosis



Type of Metamorphosis: \_\_\_\_\_



## Rubric 1.1 for Student Handout 1.1

## Life Cycles/Metamorphosis

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	2 – Approaching Standards	1 – Below Standards	Score
<b><u>Answers</u></b>	All of the answers are clearly supported with specific examples that are relevant to the question.	Most of the answers are clearly supported with specific examples that are relevant to the question.	At least two of the answers are clearly supported with specific examples that are relevant to the question.	Answers are not clearly supported with specific examples and/or are not relevant to the question.	
<b><u>Accuracy</u></b>	All supportive facts are reported accurately.	Almost all supportive facts are reported accurately.	Most supportive facts are reported accurately.	Most supportive facts are inaccurately reported.	
<b><u>Sentence Structure</u></b>	All sentences are well-constructed with varied structure.	Most sentences are well-constructed and there is some varied sentence structure.	Most sentences are well constructed, but there is no variation in structure.	Most sentences are not well-constructed or varied.	
<b><u>Grammar &amp; Spelling</u></b>	Author makes no errors in grammar or spelling that distract the reader from the content.	Author makes 1-2 errors in grammar or spelling that distract the reader from the content.	Author makes 3-4 errors in grammar or spelling that distract the reader from the content.	Author makes more than 4 errors in grammar or spelling that distract the reader from the content.	



**Student Handout 1.3** (to be completed in exhibit)

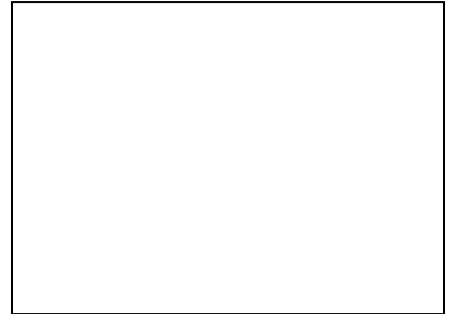
**Life Cycles/Metamorphosis**

Name: \_\_\_\_\_

Date: \_\_\_\_\_

As you travel through the *Butterflies!* exhibit at the Academy, answer the following questions.

Draw one of the pupae in the pupa chamber. Describe its color, shape, and size. Note any interesting characteristics.



Do you see any moth cocoons?

Do all of the pupae look alike or are there differences? Describe any differences. List some of the species that will emerge from these pupae.

What are the pupae doing in the chamber? What do they need at this stage in their life?

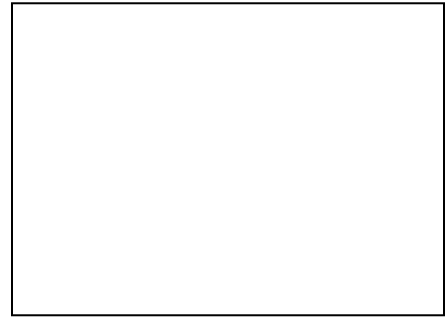
Do you see any butterflies emerging from their pupae?

Where did the butterflies in the exhibit come from?

Think about why you might not see any butterflies in the first stages of their life cycle (egg and larva) in the exhibit (**not** including inside the metamorphosis tanks). What would explain this?

As you travel through the *Butterflies!* exhibit at the Academy, answer the following questions.

Draw one of the pupae in the pupa chamber. Describe its color, shape, and size. Note any interesting characteristics.



*Answers will vary.*

Do you see any moth cocoons?

*Answers will vary.*

Do all of the pupae look alike or are there differences? Describe any differences. List some of the species that will emerge from these pupae.

*Pupae of different butterflies will look different from each other. Some will be designed to camouflage, some to stand out or to fool predators, etc. Some of the following species may be present: Monarch butterfly, Morpho butterfly, Owl butterfly, Atlas Moth – species will change depending on day of visit (pupae should have labels nearby indicating their species)*

What are the pupae doing in the chamber? What do they need at this stage in their life?

*The body structures are changing from caterpillar body parts to adult butterfly parts inside the pupae. They are firmly attached to a structure so that they remain undisturbed as they develop.*

Do you see any butterflies emerging from their pupae? If so, do they fly right away?

*Answers will vary. Butterflies will not fly right away, since their wings are crumpled and wet when they emerge. They will expand and straighten their wings by pumping blood through them and hanging from their pupae until dry.*

Where did the butterflies in the exhibit come from?

*All of the butterflies in this exhibit come from butterfly farms. The farms are in different countries around the world, including Costa Rica, Kenya, and Malaysia.*

Think about why you might not see any butterflies in the first stages of their life cycle (egg and larva) in the exhibit (**not** including inside the metamorphosis tanks). What would explain this?

*The butterfly farms ship the butterflies to the Academy in the pupal stage, and these transform into adult butterflies in the exhibit. The Academy does keep any host plants in the conservatory in order to discourage the butterflies from breeding and laying eggs. (NOTE - Eggs may sometimes be seen because the females will lay them out of instinct before dying even in the absence of correct host plants, but those eggs are either unfertilized, or caterpillars that hatch from them will not survive.)*

## Rubric 1.3 for Student Handout 1.3

## Life Cycles/Metamorphosis

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	2 – Approaching Standards	1 – Below Standards	Score
<b><u>Answers</u></b>	All of the answers are clearly supported with specific examples that are relevant to the question.	Most of the answers are clearly supported with specific examples that are relevant to the question.	At least two of the answers are clearly supported with specific examples that are relevant to the question.	Answers are not clearly supported with specific examples and/or are not relevant to the question.	
<b><u>Accuracy</u></b>	All supportive facts are reported accurately.	Almost all supportive facts are reported accurately.	Most supportive facts are reported accurately.	Most supportive facts are inaccurately reported.	
<b><u>Sentence Structure</u></b>	All sentences are well-constructed with varied structure.	Most sentences are well-constructed and there is some varied sentence structure.	Most sentences are well constructed, but there is no variation in structure.	Most sentences are not well-constructed or varied.	
<b><u>Grammar &amp; Spelling</u></b>	Author makes no errors in grammar or spelling that distract the reader from the content.	Author makes 1-2 errors in grammar or spelling that distract the reader from the content.	Author makes 3-4 errors in grammar or spelling that distract the reader from the content.	Author makes more than 4 errors in grammar or spelling that distract the reader from the content.	

## Rubric 1.R for Reflection Paragraph

## Life Cycles/Metamorphosis

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	3 – Meets Standards	1 – Below Standards	Score
<b><u>Focus or Thesis Statement</u></b>	The thesis statement names the topic of the paragraph and outlines the main points to be discussed.	The thesis statement names the topic of the paragraph.	The thesis statement outlines some or all of the main points to be discussed but does not name the topic.	The thesis statement does not name the topic AND does not preview what will be discussed.	
<b><u>Accuracy</u></b>	All supportive facts are reported accurately.	Almost all supportive facts are reported accurately.	Most supportive facts are reported accurately.	Most supportive facts are inaccurately reported.	
<b><u>Sentence Structure</u></b>	All sentences are well-constructed with varied structure.	Most sentences are well-constructed and there is some varied sentence structure.	Most sentences are well constructed, but there is no variation in structure.	Most sentences are not well-constructed or varied.	
<b><u>Grammar &amp; Spelling</u></b>	Author makes no errors in grammar or spelling that distract the reader from the content.	Author makes 1-2 errors in grammar or spelling that distract the reader from the content.	Author makes 3-4 errors in grammar or spelling that distract the reader from the content.	Author makes more than 4 errors in grammar or spelling that distract the reader from the content.	

**Target:** 5-8<sup>th</sup> Grade

**Duration:** One 45-minute lesson w/extension options and parent links

**Discipline Connections:** Science, Math, English, Visual Arts, Technology, Geography

**Before Lesson/Materials:** Create duration chart (*see Procedure Step #12*); copies of Student Handout 2.1, Rubric 2.1 and Rubric 2.R for each student; scissors, glue

**Word Bank:** Metamorphosis, Life Cycle, Egg, Larva, Molt, Pupa, Adult (Butterfly), and Chrysalis

**Objective:** Students will demonstrate their ability to describe the metamorphosis of a butterfly chronologically. (This lesson is based on a Monarch butterfly.)

**Background:** In this lesson, students will create a collage to depict the metamorphosis of a butterfly. Students will also write reflection pieces related to the objectives.

**Focusing Question:** If you could be any animal, what would you be? Think about the changes your body would have to undergo to become that animal. Now write to describe how your body changes into the animal. Use details such as the amount of time it takes, the step by step process, where you are when the changes take place, and what someone else would observe if they watched you change.

**Procedure:**

1. Have students respond in writing to the focusing question. Select a few students to share highlights from their responses.
2. Explain that students will learn about a dramatic change of a real-life creature.
3. State the lesson's objective and write the objective on the board.
4. Pass out Student Handout 2.1, depicting the life cycle of the butterfly, and Rubric 2.1.
5. Ask students to cut out the pictures and place the pictures in the order that they believe shows the metamorphosis of the butterfly. (*If scissors and glue are not available, have the students use pencils to write a number next to each picture to show the order.*) Have students share their ideas with a partner.
6. Choose two students who have a difference of opinion to share out their ideas and explanations.
7. Read the READ ALOUD (Teacher Handout 2.1).
8. Work with the class to arrange their pictures in the correct order. Be sure to discuss each stage of metamorphosis.
9. Have students glue their pictures in order on a separate piece of paper and label each picture with the new vocabulary.
10. Have students estimate the amount of time that it takes for the butterfly to go through each stage. Remind them that the entire process takes approximately 6-10 weeks.
11. Display a chart showing the time lapses in each stage, and allow students time to confirm or change their estimates. (*See READ ALOUD for times of stages.*)

**Reflection:** Ask students to write two paragraphs explaining the metamorphosis of a butterfly. Have several students share out their paragraphs. Distribute Rubric 2.R.

**Assessment:** Completed Collage, Reflection Journal Response

**Extension Options:**

- Read the book entitled, From Caterpillar to Butterfly by Deborah Heiligman (published by HarperCollins Publishers, ISBN 0-06-445129-1) and have students replace the illustrations with their own illustrations.
- Have students create flipbooks to show the metamorphosis process.  
*Flipbook resource:* <http://www.readwritethink.org/materials/flipbook/>
- Have students use tape recorders to record their thoughts and feelings from inside the chrysalis using the butterfly's perspective (*if tape recorders are not available, have students write diary entries*). Have the students think about what it feels like to change and what it feels like to be inside the chrysalis. Discuss their feelings of anticipation, and make sure they realize that if the chrysalis is threatened they can't move.
- Have students create a teaching poster with a diagram showing the metamorphosis of the butterfly, and have them use the poster to teach other students from different classes.
- Use the internet to research other types of butterflies and create a Venn diagram comparing and contrasting the different metamorphosis times and processes. Use the following website to help you find information on 3 different types of butterflies:  
<http://www.shrewsbury-ma.gov/schools/beal/curriculum/butterfly/cycle/index.htm>

**Parent-Links:**

- Have students and parents co-write a letter to baby caterpillars explaining why they need to eat their veggies.
- Have students and parents create their own fantasy butterflies using personal designs with symbols that are important to their family.

**Resources:**

- <http://www.exhibits.pacsci.org/insects/buttermoth.html>
- <http://www.readwritethink.org/materials/flipbook/>
- [www.amazon.com](http://www.amazon.com)
- <http://www.shrewsbury-ma.gov/schools/beal/curriculum/butterfly/cycle/index.htm>

**Standards:**

**Philadelphia City Standards:** Reading 1, 3; Writing 1, 2, 3; Speaking 1, Listening 1, Social Studies 2; Science 1, 3, 5, 6; Math 1, 2, 6, 9; Art 1, 7

**Pennsylvania State Standards:** Reading, Writing, Speaking, Listening 1.1, 1.2, 1.4, 1.5, 1.6, 1.8; Geography 7.4A and B; Science and Technology 3.1A and E, 3.3.A and B, 3.6B, 3.7C and E; Family and Consumer Sciences #11.2H; Math 2.2, 2.3, 2.5, Art 9.1B, I, J, and K

Metamorphosis of a Butterfly



**READ ALOUD**

The life cycle for an average Monarch butterfly lasts approximately 6-10 weeks. Like all butterflies, monarchs go through 4 distinct stages in their life cycles, a process called metamorphosis. The life cycle begins when a female adult Monarch first lays its eggs. Eggs are always laid on milkweed plants, because milkweed is the Monarch's host plant (the only food that Monarch caterpillars will eat). Each egg is only a few millimeters in diameter.

***(Pause)** Ask students for an example of something around them that would be the same size - tip of a pencil, width of a dime, etc.)*

The egg stage lasts about 4-6 days, and then a tiny caterpillar hatches out and immediately starts eating. It eats its egg shell first and then begins munching on the milkweed. For around 2-4 weeks, the caterpillar eats continuously and grows, getting thousands of times bigger. It molts, or sheds its skin 4 times as it grows.

***(Pause)** Ask students to restate the first two life cycle stages and to explain why the caterpillar sheds its skin - the caterpillar keeps growing and its skin keeps getting too tight to contain it)*

The third stage of a Monarch's life cycle is the pupa or chrysalis. Around 2-4 weeks after hatching from the egg, the full-grown caterpillar sheds its skin a fifth time to form the chrysalis. The body changes completely within the pupa over about 10-14 days, after which time an adult butterfly emerges. An observer can determine how far along the pupa stage is by the color of the chrysalis. It looks green at first but changes as the butterfly gradually develops inside. Before the adult is ready to emerge, the chrysalis looks clear and the colors of the butterfly's body can be seen within.

***(Pause)** Ask students to describe how the chrysalis changes - the color of the chrysalis changes from green to the color of the butterfly inside)*

The adult butterfly is the fourth and final stage of the Monarch's life. An adult Monarch usually emerges from its chrysalis around 5-6 weeks into its life cycle. This adult butterfly typically lives another 2-6 weeks. The amount of time that the adult butterfly survives depends on factors such as predators and weather. The adult's main goal in its short life span is to mate and lay eggs. The next generation of Monarchs can then begin their life cycles.

***(Pause)** Ask students what surprised them the most about the metamorphosis process)*

**(DO NOT READ ALOUD THE INFORMATION BELOW)****Stage Length**

<i>Egg Stage</i>	<i>Caterpillar Stage</i>	<i>Chrysalis Stage</i>	<i>Butterfly Stage</i>
4-6 Days	14-28 Days	10-14 Days	14-42 Days



**Rubric 2.1 for Student Handout 2.1/Collage**

**Life Cycles/Metamorphosis**

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	2 – Approaching Standards	1 – Below Standards	Score
<b><u>Labels</u></b>	The metamorphosis process has creative labels that accurately describe the material and are easy to locate.	The metamorphosis process has effective labels that accurately describe the material and are easy to locate.	The metamorphosis process has labels that are easy to locate.	The labels are missing or difficult to locate.	
<b><u>Knowledge Acquired</u></b>	The student can accurately describe 75% (or more) of the events on the metamorphosis process without referring to it and can quickly determine which of two events occurred first.	The student can accurately describe 50% of the events on the metamorphosis process without referring to it and can quickly determine which of two events occurred first.	The student can describe any event on the metamorphosis process if allowed to refer to it and can determine which of two events occurred first.	The student cannot use the metamorphosis process effectively to describe events or to compare events.	
<b><u>Use of Class Time</u></b>	Classroom time was used to work on the project. Conversations were not disruptive and focused on the work.	Classroom time was used to work on the project the majority of the time. Conversations were not disruptive and focused on the work.	Classroom time was used to work on the project the majority of the time, but conversations often were disruptive or did not focus on the work.	Student did not use classroom time to work on the project and/or was highly disruptive.	
<b><u>Readability</u></b>	The overall appearance of the timeline is pleasing and easy to read.	The overall appearance of the timeline is somewhat pleasing and easy to read.	The timeline is relatively readable.	The timeline is difficult to read.	

## Rubric 2.R Reflection Paragraph about Metamorphosis

## Life Cycles/Metamorphosis

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	2 – Approaching Standards	1 – Below Standards	Score
<b><u>Focus</u></b>	Topic/subject is clear, though it may/may not be explicitly stated.	Topic/subject is generally clear though it may not be explicitly stated.	Topic/subject may be vague.	Topic/subject is unclear or confusing.	
<b><u>Organization</u></b>	Organizational structure establishes relationship between/among ideas/events.	Organizational structure establishes relationships between ideas/events, although minor lapses may be present.	Organizational structure establishes some relationship between/among some of the ideas/events. The structure is minimally complete.	Organizational structure does not establish connection between/among ideas/events. The overall structure is incomplete or confusing.	
<b><u>Support</u></b>	Support information is related to and supportive of the topic/subject.	Support information has minor weaknesses in relatedness to and/or support of the topic/subject.	Support information has major weaknesses in relatedness to and/or support of the topic/subject.	An attempt has been made to add support information, but it was unrelated or confusing.	
<b><u>Grammar &amp; Spelling</u></b>	Writer makes no errors in grammar or spelling.	Writer makes 1-2 errors in grammar and/or spelling.	Writer makes 3-4 errors in grammar and/or spelling.	Writer makes more than 4 errors in grammar and/or spelling.	

## Lesson #3

## Theme: Life Cycles

## Topic: Life Stages

**Target:** 5<sup>th</sup>-8<sup>th</sup> Grade

**Duration:** One 45- minute lesson w/ extensions options and parent links

**Discipline Connections:** Science, English, Visual Arts, Social Studies, Technology, Geography, Math

**Before the Lesson/ Materials:** Copies of Student Handouts 3.1 and 3.4 (optional) and Rubrics 3.1, 3.4 (optional), and 3.R for each student; make copies and cut out one set of “Insect or Not?” Cards 3.2 and one set of Butterfly Life Stages Cards 3.3 per group of four students

**Word Bank:** Insect, Exoskeleton, Metamorphosis, Egg, Larva, Pupa, Chrysalis, Adult Butterfly, Thorax, Abdomen, Antennae, Compound Eyes

**Objective:** Students will demonstrate their understanding of the six basic characteristics of an insect. They will also consider how butterflies spend their lives during the four stages of metamorphosis.

**Background:** Insects, including butterflies, are described by six physical characteristics in their adult form: an exoskeleton, three body parts (head, thorax, abdomen), six jointed legs, two antennae, two compound eyes, and wings (with a few exceptions). Almost all insects undergo some type of metamorphosis. Butterflies undergo complete metamorphosis, moving through four distinct stages of life: egg, larva (caterpillar), pupa (chrysalis), and adult. A butterfly’s entire life span can last anywhere from less than a month to more than a year.

**Focusing Question:** What do you think makes an insect an insect? In the space below, draw what you think an insect looks like.

### **Procedure:**

1. Distribute Student Handout 3.1 and Rubric 3.1.
2. Have students respond in writing to the focusing question and select a few students to share highlights from their responses.
3. State the lesson’s objective and write the objective on the board.
4. Discuss with the class the six characteristics of an adult insect and have students list them on their handouts and draw an accurate insect.
5. Divide students into groups of four each and distribute “Insect or Not?” Cards (3.2).
6. Have students divide cards into 2 groups, Insect or Not, and list them on their handouts.
7. Review the correct answers with the class. Remind students that insects must have all six characteristics listed on their worksheet.
8. Distribute four Butterfly Life Stages Cards 3.3 (one of each stage) per group of four.
9. Discuss with the class the 4 stages of complete metamorphosis in butterflies and the statement about form and function. Have students answer the questions.
10. Review the answers to the questions on each card.
11. Additional class time may be needed to review answers.

### **Museum Activities (optional):**

12. At the Academy’s *Butterflies!* exhibit, students will observe the four life stages of a butterfly.
13. Distribute Student Handout 3.4 and Rubric 3.4.

### **Reflection:**

Distribute Rubric 3.R and have students respond to the following journal prompt: Pretend that you are a butterfly and describe what you are doing and what you are feeling in each stage of butterfly metamorphosis. How long do you think you might spend in different stages and why?

**Assessment:** Completed Student Handout 3.1, Life Stages Cards 3.3, Student Handout 3.4, and Reflection Paragraph

### **Extension Options:**

- Using the library or internet resources, have students research one of the organisms found on the “Insect or Not?” cards.
- Have students take the “Insect or Not?” cards (or have them make their own “Insect or Not?” cards to use) to a lower level class. Have them teach those students about what they know about insects.
- Have students design an insect using household materials. They may model their insect after an identified insect or they may create an imaginary insect. Remind them to include the six characteristics of an insect in the design and have them make sure that the insect is well adapted to living in its habitat. Their insects should have a name. Tell them that scientific names often come from the way people choose to describe an animal (e.g., *Tyrannosaurus rex* means “terrible lizard king”) or are named after the discoverer.
- Have students research how and where butterflies in all life stages survive the winter. A good article about butterfly migration can be found at the following site:  
[http://news.nationalgeographic.com/news/2001/03/0327\\_Monarchs.html](http://news.nationalgeographic.com/news/2001/03/0327_Monarchs.html)

### **Parent-Links:**

- Have students study how some butterflies migrate long distances to avoid cold winter temperatures. Migration and tagging records can be found at the following website:  
<http://www.Monarchwatch.org/tagmig/urq1.htm>
  - a. How are butterflies tagged?
  - b. Look for patterns in the migration maps.
  - c. What changes have occurred over the last 30 years?
  - d. Where do Monarchs on the East Coast usually go?
  - e. Monarch butterflies do not migrate with their parents. They undertake their journeys on their own. How do you think they know where to go?
  - f. What advantage does migration offer butterflies? What disadvantage does migration impose on butterflies?

### **Resources:**

- [www.Monarchwatch.org](http://www.Monarchwatch.org)
- <http://www.learner.org/jnorth/>
- <http://whyfiles.org/006migration/index.html>
- <http://www.worldwildlife.org/Monarchs/>

### **Standards:**

**Philadelphia City Standards:** Reading 1,2,3; Writing 1,2,3; Speaking 1; Listening 1; Social Studies 3; Science 1,2,3,5,6; Math 9; Arts 1,7

**Pennsylvania State Standards:** Reading, Writing, Speaking, Listening 1.1,1.2,1.4,1.5,1.6,1.8; Geography 7.1A-B, 7.4A-B; Science and Technology 3.1A and E, 3.3A-B, 3.6B, 3.7 C,E; Family and Consumer Sciences 11.2H; Math 2.3, 2.5, 2.6, Art 9.1 B, I, J, and K, Environment and Ecology 4.5A, 4.7B

# Student Handout 3.1

# Life Cycles/Life Stages

Name: \_\_\_\_\_

Date: \_\_\_\_\_

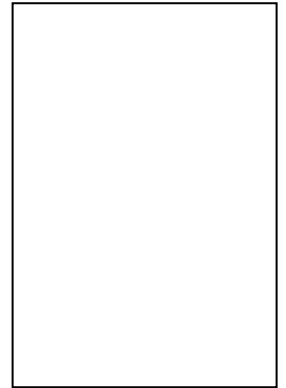
### Focusing Question:

What do you think makes an insect an insect? In the space below draw what you think an insect looks like:



List below the six characteristics of an insect that your teacher describes and draw an accurate insect in the space to the right:

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_



Classify each of the following cards as an insect or not:

**Insect**

**or**

**Not?**



## 4 Stages of Complete Metamorphosis in a Butterfly

\_\_\_\_\_ → \_\_\_\_\_ → \_\_\_\_\_ → \_\_\_\_\_

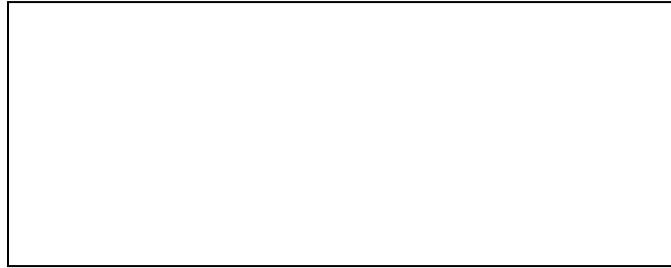
### **Form and Function in Nature**

*What Does it Look Like and Why?*

In other words, the way that a structure is built or formed helps the living organism perform its function, or its job.

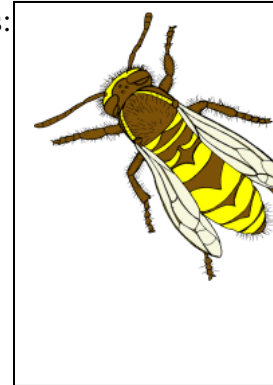
Focusing Question:

What do you think makes an insect an insect? In the space below draw what you think an insect looks like. *Answers will vary.*



List below the six characteristics of an insect that your teacher describes:

- |  |                             |
|--|-----------------------------|
| 1. <i>exoskeleton</i>  | 4. <i>wings</i>             |
| 2. <i>three body parts</i><br><i>(head, thorax, abdomen)</i> | 5. <i>two antennae</i>      |
| 3. <i>six jointed legs</i>                                   | 6. <i>two compound eyes</i> |



Classify each of the following cards as an insect or not:

**Insect**

**or**

**Not?**

*butterflies*  
*dragonflies*  
*beetles*  
*termites*  
*flies*  
*bees*  
*ladybugs*

*mites are arachnids*  
*centipedes are chilopods*  
*earthworms are annelids (not arthropods)*  
*crabs are crustaceans*  
*ticks are arachnids*  
*spiders are arachnids*  
*millipedes are diplopods*  
*slugs are mollusks (not arthropods)*

**4 Stages of Complete Metamorphosis in a Butterfly**

    Egg     →     Larva     →     Pupa     →     Adult Butterfly    

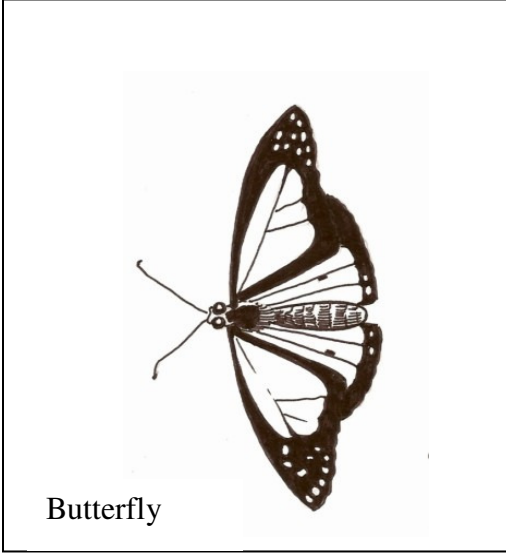
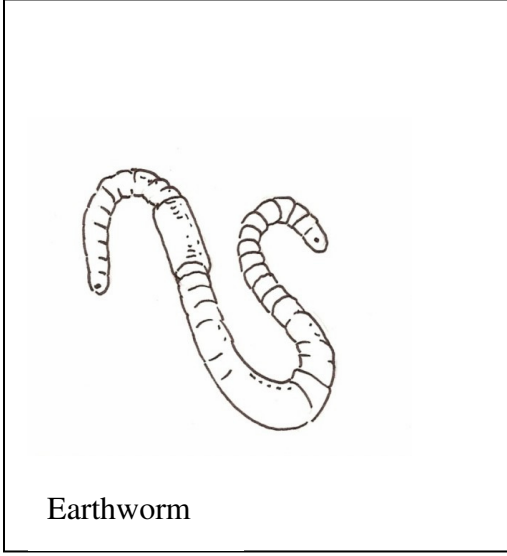
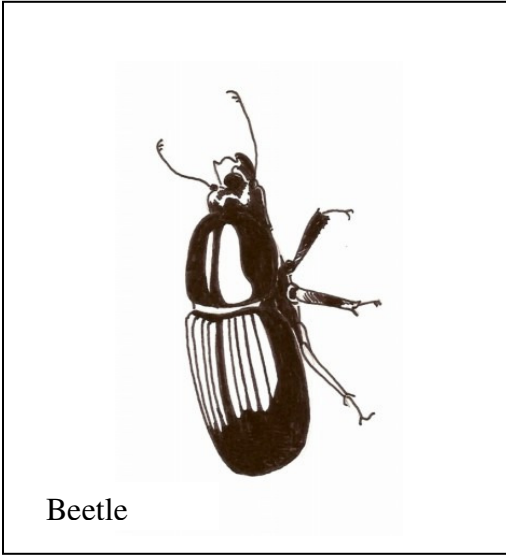
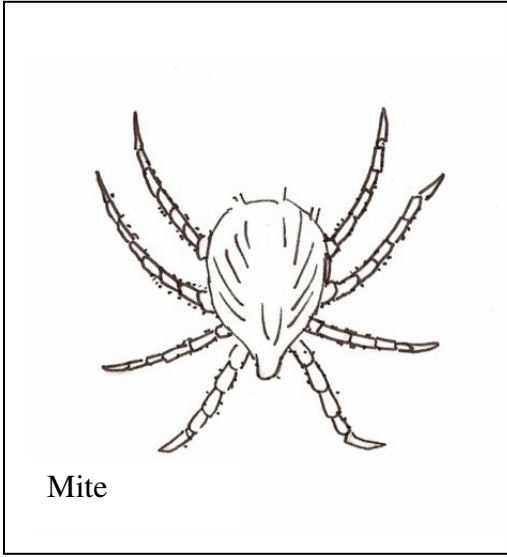
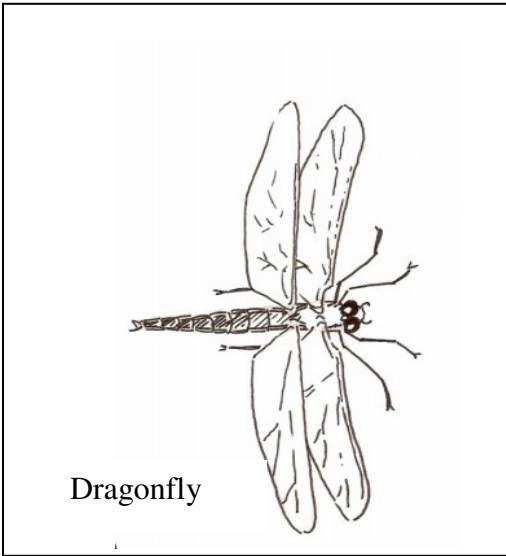
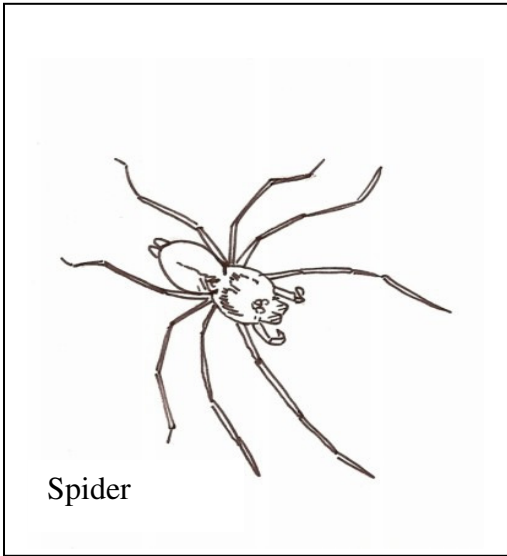
**Form and Function in Nature**

***What Does it Look Like and Why?***

In other words, the way that a structure is built or formed helps the living organism perform its function, or its job.

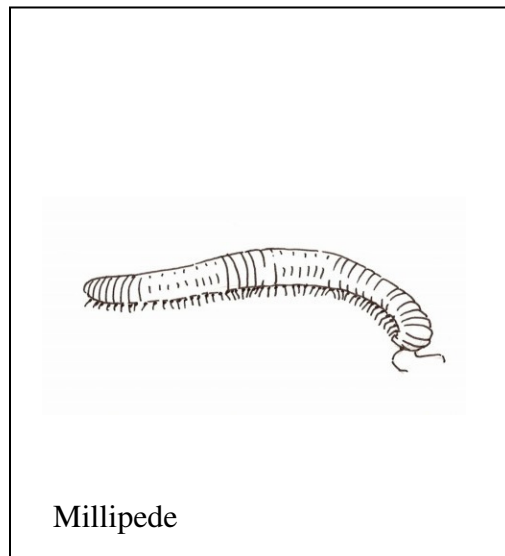
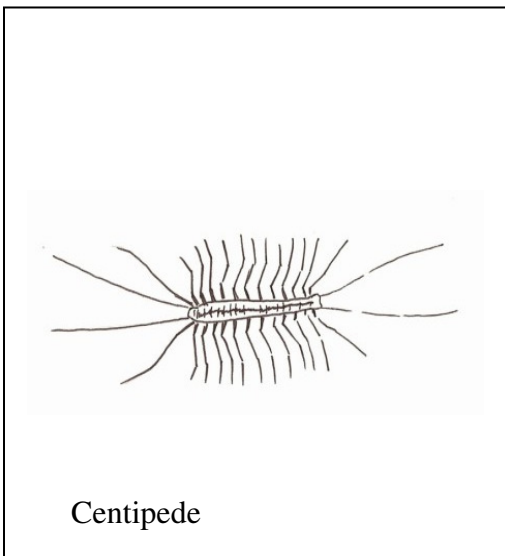
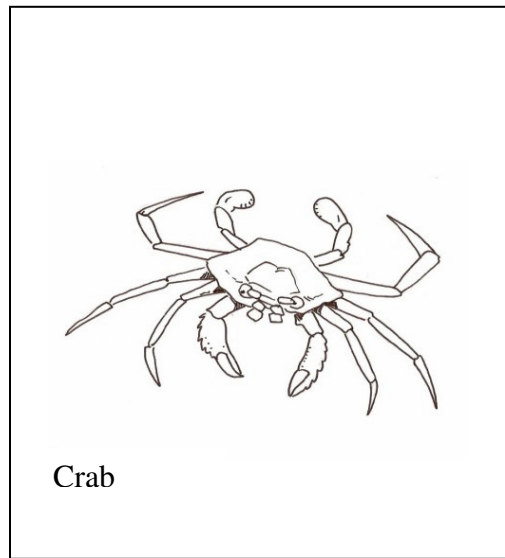
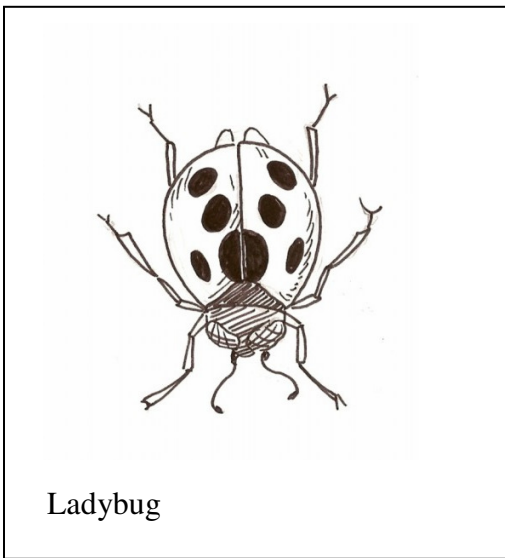
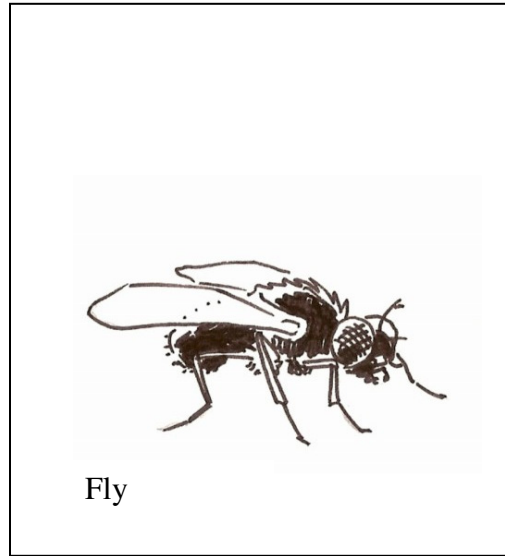
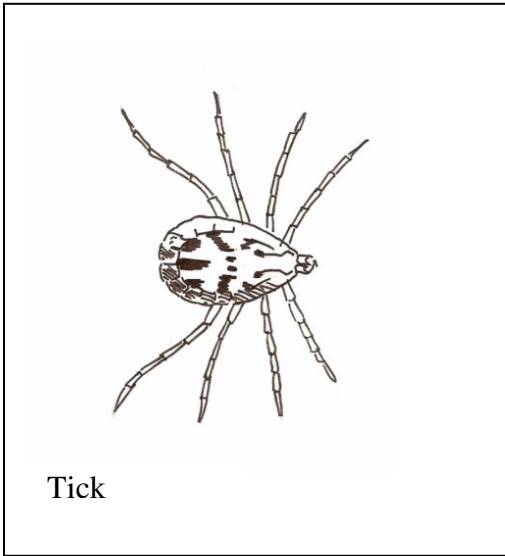
**Insect or not cards 3.2**

**Life Cycle/Life Stages**



### Insect or not cards 3.2

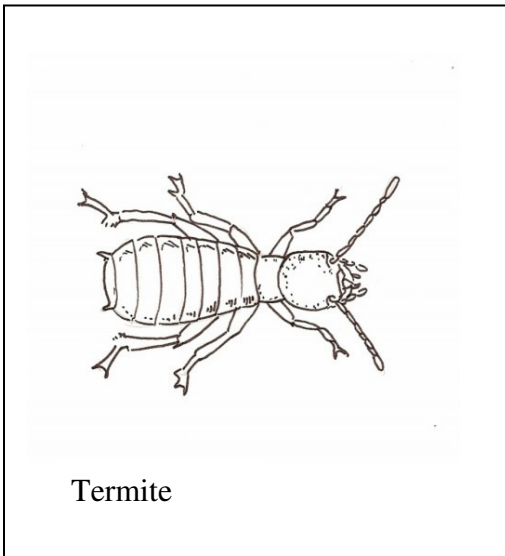
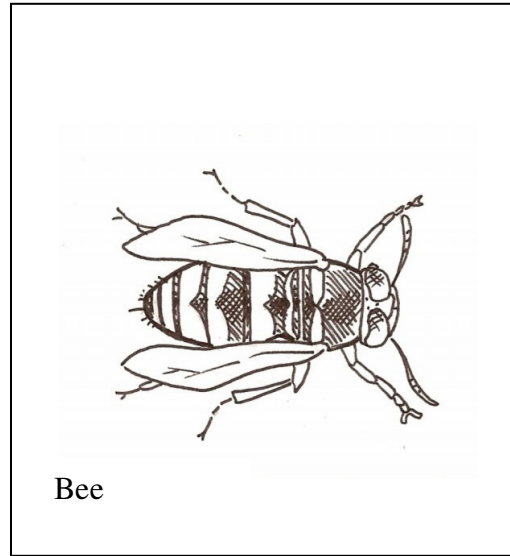
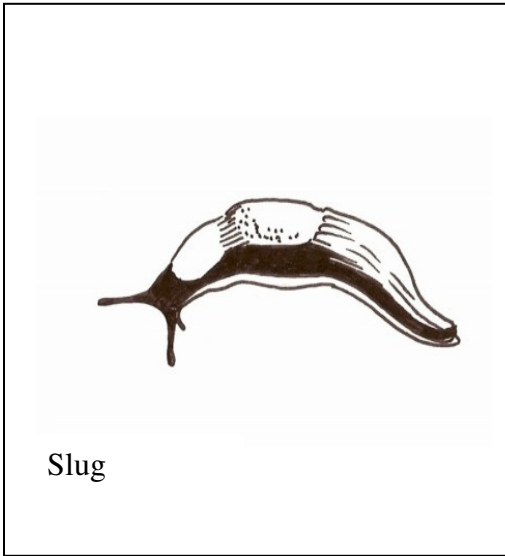
### Life Cycle/Life Stages





### Insect or not cards 3.2

### Life Cycle/Life Stages



## Egg

*What Does it Look Like and Why?*



The function or job of the egg is to hatch. Describe the form or structure of the egg. Think about how the form might help the egg survive until it hatches. Think about examples of eggs in other animals.

Butterflies can lay hundreds of eggs during their lives! Some may lay dozens at a single time. Why do you think they lay so many eggs?

## Larva

*What Does it Look Like and Why?*



The function or job of the larva is to grow. Some larvae can grow many thousands of times their original size! Describe the form or structure of the larva. Think about what it needs in order to grow. How does it get what it needs?

How do you think larvae grow if they have a hard outer skin, also known as an exoskeleton?

Why do you think this is often one of the longest stages in the life cycle of a butterfly?

## Pupa

*What Does it Look Like and Why?*



The function or job of the pupa is to transform and develop. Describe the form or structure of the pupa.

Pupae have to attach themselves to a firm support. Why?

Some butterflies spend the winter months as a pupa. Why do you think this is a good adaptation?

## Adult

*What Does it Look Like and Why?*



The function or job of the adult butterfly is to find a mate and breed (and lay eggs, if female). Describe the form or structure of the butterfly.

How do adults get enough energy to stay alive and to reproduce?

Adult female butterflies generally lay eggs on a specific host plant because that is the only food that their caterpillars will eat after hatching. Why do you think it is so important for adult butterflies to recognize host plants? How do you think they find the host plants?

## Egg

*What Does it Look Like and Why?*



The function or job of the egg is to hatch. Describe the form or structure of the egg. Think about how the form might help the egg survive until it hatches. Think about examples of eggs in other animals.

*Round, small; individual eggs may be easy to hide, or else many eggs may be laid together so that at least some survive; eggshell protects the developing larva*

Butterflies may lay hundreds of eggs during their lives. Some species lay dozens at a single time! Why do you think they lay so many eggs?

*It is an adaptation for survival, because not all eggs will hatch. Many eggs get eaten or damaged by weather, etc. Eggs hatch within a few days of being laid.*

## Larva

*What Does it Look Like and Why?*



The function or job of the larva is to grow. Some larvae can grow many thousands of times their original size! Describe the form or structure of the larva. Think about what it needs in order to grow. How does it get what it needs?

*Long, worm-like, many prolegs (false legs) and six legs to help it get to and hold onto its food source; no "seeing" eyes, but antennae and mouth help it sense food; strong, powerful chewing mouth parts for eating, to get energy to grow*

How do you think larvae grow if they have a hard outer skin, also known as an exoskeleton?

*They molt (shed their exoskeleton); they can shed 4-5 times as larvae.*

Why do you think this is often one of the longest stages in the life cycle of a butterfly?

*Because this is the stage when butterflies do all their growing; larvae store up energy needed for the pupal stage so that they can transform into adult butterflies*

## Pupa

*What Does it Look Like and Why?*



The function or job of the pupa is to transform and develop. Describe the form or structure of the pupa.

*The pupa is case-like, tightly sealed and enclosed. No obvious appendages/sensory organs – not needed because pupa doesn't move around, all activity happens inside*

Pupae have to attach themselves to a firm support. Why?

*Pupae need to be undisturbed so the larvae can transform into adults.*

*Emerging butterflies also need to be able to hang from their pupae to help wings expand and dry.*

Some butterflies spend the winter months as a pupa. Why do you think this is a good adaptation? *They are well protected and enclosed within pupal covering.*

## Adult

*What Does it Look Like and Why?*



The function or job of the adult butterfly is to find a mate and breed (and lay eggs, if female). Describe the form or structure of the butterfly.

*Four strong wings to fly, two antennae to smell and sense their surroundings, two compound eyes to see – all these features are needed to help them find food and mates. Bright colors attract mates. Proboscis (drinking tube) allows them to eat.*

How do adults get enough energy to stay alive and to reproduce?

*By eating (drinking) flower nectar through their proboscis*

Adult female butterflies generally lay eggs on a specific host plant because that is the only food that their caterpillars will eat after hatching. Why do you think it is so important for butterflies to recognize host plants? How do you think they find host plants? *Larvae have a better chance of surviving because won't have to travel far to eat - they eat from the host plant they are laid on. Butterflies use sight and smell to find host plants, then taste plants with their feet to make sure.*

### Rubric 3.1 for Student Handout 3.1

### Life Cycles/Life Stages

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	2 – Approaching Standards	1 – Below Standards	Score
<b><u>Answers</u></b>	All of the answers are clearly supported with specific examples that are relevant to the question.	Most of the answers are clearly supported with specific examples that are relevant to the question.	At least two of the answers are clearly supported with specific examples that are relevant to the question.	Answers are not clearly supported with specific examples and/or are not relevant to the question.	
<b><u>Accuracy</u></b>	All supportive facts are reported accurately.	Almost all supportive facts are reported accurately.	Most supportive facts are reported accurately.	Most supportive facts are inaccurately reported.	
<b><u>Sentence Structure</u></b>	All sentences are well-constructed with varied structure.	Most sentences are well-constructed and there is some varied sentence structure.	Most sentences are well constructed, but there is no variation in structure.	Most sentences are not well-constructed or varied.	
<b><u>Grammar &amp; Spelling</u></b>	Author makes no errors in grammar or spelling that distract the reader from the content.	Author makes 1-2 errors in grammar or spelling that distract the reader from the content.	Author makes 3-4 errors in grammar or spelling that distract the reader from the content.	Author makes more than 4 errors in grammar or spelling that distract the reader from the content.	

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Start a list of insects that you see on your way to or from the museum. Keep adding insects to this list as you see them in your daily life.

Answer the following questions as you travel through the conservatory (butterfly garden). Ignore the contents of the metamorphosis tanks in your answers.

Do you see any butterflies in the egg stage? Why?

Do you see any butterflies in the larval stage? Why?

Do you see any butterflies in the pupal stage? Describe what they are doing.

Do you see any butterflies in the adult stage? Describe what they are doing.

Do you see any butterflies laying eggs? Why?

---

Write a letter to the butterfly keeper. Don't forget to leave your letter with an Academy employee at the exhibit.

My 2 favorite parts of the exhibit are:

List 2 questions that you have for the supervisor about the exhibit or about butterflies:

Suggest one thing that might make this exhibit even better:

Optional:

My name is \_\_\_\_\_ and I attend \_\_\_\_\_ School.

Grade: \_\_\_\_\_

Date: \_\_\_\_\_

Start a list of insects that you see on your way to or from the museum. Keep adding insects to this list as you see them in your daily life.

*Answers will vary.*

Answer the following questions as you travel through the *Butterflies!* conservatory (butterfly garden). Ignore the contents of the metamorphosis tanks in your answers.

Do you see any butterflies in the egg stage? Why?

*No, because the butterflies are shipped in the pupal stage, and the adults do not usually breed in the conservatory because their host plants are not provided. (NOTE - Eggs may sometimes be seen because the females will lay them out of instinct before dying even in the absence of correct host plants, but those eggs are either unfertilized, or caterpillars that hatch from them will not survive.)*

Do you see any butterflies in the larval stage? Why?

*No, because the butterflies are shipped in the pupal stage, and the adults don't breed in the conservatory.*

Do you see any butterflies in the pupal stage? Describe what they are doing.

*Yes, they are hanging, firmly attached to a support. Inside, the bodies are transforming from caterpillars to adult butterflies. Pupae might be totally still, moving slightly, or even splitting open.*

Do you see any butterflies in the adult stage? Describe what they are doing.

*Yes. They may be flying around, resting, chasing others, puddling (males drinking water in groups from small puddles of water to obtain dissolved minerals), feeding on flower nectar or rotting fruit, sometimes mating*

Do you see any butterflies laying eggs? Why?

*No, because the host plants for the caterpillars are not present. (OR, some females may be laying eggs out of instinct, as mentioned above.)*

-----  
Write a letter to the butterfly keeper. Don't forget to leave your letter with an Academy employee at the exhibit.

My 2 favorite parts of the exhibit are:

*Answers will vary.*

List 2 questions that you have for the supervisor about the exhibit or about butterflies:

*Answers will vary.*

Suggest one thing that might make this exhibit even better:

*Answers will vary.*

Optional:

My name is \_\_\_\_\_ and I attend \_\_\_\_\_ School.

Grade: \_\_\_\_\_ Date: \_\_\_\_\_



### Rubric 3.4 for Student Handout 3.4

### Life Cycles/Life Stages

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	2 – Approaching Standards	1 – Below Standards	Score
<b><u>Answers</u></b>	All of the answers are clearly supported with specific examples that are relevant to the question.	Most of the answers are clearly supported with specific examples that are relevant to the question.	At least two of the answers are clearly supported with specific examples that are relevant to the question.	Answers are not clearly supported with specific examples and/or are not relevant to the question.	
<b><u>Accuracy</u></b>	All supportive facts are reported accurately.	Almost all supportive facts are reported accurately.	Most supportive facts are reported accurately.	Most supportive facts are inaccurately reported.	
<b><u>Sentence Structure</u></b>	All sentences are well-constructed with varied structure.	Most sentences are well-constructed and there is some varied sentence structure.	Most sentences are well constructed, but there is no variation in structure.	Most sentences are not well-constructed or varied.	
<b><u>Grammar &amp; Spelling</u></b>	Author makes no errors in grammar or spelling that distract the reader from the content.	Author makes 1-2 errors in grammar or spelling that distract the reader from the content.	Author makes 3-4 errors in grammar or spelling that distract the reader from the content.	Author makes more than 4 errors in grammar or spelling that distract the reader from the content.	

## Rubric 3.R for Reflection Paragraph

## Life Cycles/Life Stages

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	3 – Meets Standards	1 – Below Standards	Score
<b><u>Focus or Thesis Statement</u></b>	The thesis statement names the topic of the paragraph and outlines the main points to be discussed.	The thesis statement names the topic of the paragraph.	The thesis statement outlines some or all of the main points to be discussed but does not name the topic.	The thesis statement does not name the topic AND does not preview what will be discussed.	
<b><u>Accuracy</u></b>	All supportive facts are reported accurately.	Almost all supportive facts are reported accurately.	Most supportive facts are reported accurately.	Most supportive facts are inaccurately reported.	
<b><u>Sentence Structure</u></b>	All sentences are well-constructed with varied structure.	Most sentences are well-constructed and there is some varied sentence structure.	Most sentences are well constructed, but there is no variation in structure.	Most sentences are not well-constructed or varied.	
<b><u>Grammar &amp; Spelling</u></b>	Author makes no errors in grammar or spelling that distract the reader from the content.	Author makes 1-2 errors in grammar or spelling that distract the reader from the content.	Author makes 3-4 errors in grammar or spelling that distract the reader from the content.	Author makes more than 4 errors in grammar or spelling that distract the reader from the content.	

**Target:** 5-8<sup>th</sup> Grade

**Duration:** One 45-minute lesson w/extension options and parent links

**Discipline Connections:** Science, Math, English, Visual Arts, Technology

**Before Lesson/Materials:** Copies of Handout 4.1 for half of student groups, copies of Handout 4.2 for other half of groups; copies of Student Handout 4.3 “Jigsaw” for each group; copies of Rubrics 4.3 and 4.R for each student; chart paper, markers, construction paper, tape

**Word Bank:** Climate, Migration, Diapause, Dormancy, Hibernation, Overwinter

**Objective:** Students will be able to explain the different ways in which butterflies living in seasonal environments survive the winter.

**Background:** In this lesson, students will create informational charts and flyers to explain migration and diapause.

**Focusing Question:** Imagine that you are a delicate animal with arms made of very thin, flexible paper. Explain how you would keep yourself safe during the wintertime. Consider factors such as snow, freezing rain, high winds, and cold temperatures.

**Procedure:**

1. Have the students respond in writing to the focusing question. Select a few students to share highlights from their responses.
2. Explain that students will learn about how a butterfly survives the winter.
3. State the lesson’s objective and write the objective on the board.
4. Divide students into groups of four to six students.
5. Give each group one of the two informational handouts, Student Handout 4.1 or Student Handout 4.2. About half the class should have the information on Migration, and the other half on Diapause.
6. Distribute Student Handout 4.3 (Jigsaw Activity Roles and Responsibilities) and Rubric 4.3 to each group.
7. Review the directions provided on the “Jigsaw” handout as needed and allow time for students to complete their informational charts.
8. Have each group report out to the entire class.
9. Hang charts in the room so that students can see each one clearly or have access to each one.

**Reflection:** Ask students to create a one-page Butterfly Flyer using two facts from each chart. Explain to the students that the flyers will be hung in the hallway as a display of their knowledge. Distribute Rubric 4.R.

**Assessment:** Completed informational chart, Butterfly Flyer

### **Extension Options:**

- Read the Greek myth of Danaus and his daughters (the Danaids). Have students explain how the long journey of migrating Monarch butterflies is reminiscent of the Danaids' flight. (*You may wish to preview a version of the myth for age level appropriateness.*)
- Have students create a slide show to show the life cycle of a butterfly. Make sure students include winter survival strategies. Slide show application program and resource: [http://www.cap.nsw.edu.au/kidpix/kid\\_pix.html](http://www.cap.nsw.edu.au/kidpix/kid_pix.html)
- Have students use tape recorders to record their thoughts and feelings during diapause (hibernation) using the butterfly's perspective. (*If tape recorders are not available, students can write diary entries.*)
- Have students create a teaching kit of butterfly manipulatives and use these materials to teach other students about the life cycles of butterflies.

### **Parent-Links:**

- Make a butterfly life cycle mobile. See detailed directions at [http://www.enchantedlearning.com/crafts/butterfly/life\\_cyclemobile/](http://www.enchantedlearning.com/crafts/butterfly/life_cyclemobile/)
- Play butterfly games and word puzzles at: <http://www.teachers.ash.org.au/jmresources/butlifecycle/fun.html>
- Make a three-dimensional butterfly life cycle craft using a roll of toilet paper. Find out how at: <http://www.hhmi.org/coolscience/butterfly/index.html>

### **Resources:**

- <http://library.thinkquest.org/27968/predators.shtml>
- <http://www.hhmi.org/coolscience/butterfly/index.html>
- [http://www.enchantedlearning.com/crafts/butterfly/life\\_cyclemobile/](http://www.enchantedlearning.com/crafts/butterfly/life_cyclemobile/)
- [http://www.cap.nsw.edu.au/kidpix/kid\\_pix.html](http://www.cap.nsw.edu.au/kidpix/kid_pix.html)
- [http://www.teachers.ash.org.au/jmresources/butlife\\_cycle/fun.html](http://www.teachers.ash.org.au/jmresources/butlife_cycle/fun.html)

### **Standards:**

***Philadelphia City Standards:*** Reading 1, 2, 3; Writing 1, 2, 3; Speaking 1, Listening 1, Social Studies 3; Science 1, 2, 3, 5, 6; Math 1, 2, 6, 9; Art 1, 7

***Pennsylvania State Standards:*** Reading, Writing, Speaking, Listening 1.1, 1.2, 1.4, 1.5, 1.6, 1.8; Geography 7.4A and B; Science and Technology 3.1A and E, 3.3.A and B, 3.6B, 3.7C and E; Family and Consumer Sciences 11.2H; Math 2.2, 2.3, 2.4, 2.5, 2.6, Art 9.1B, I, J, and K; Environment and Ecology 4.5A, 4.7B

**Strategy 1: Migration (flying south)**

Do you ever wonder where all the insects have gone in the wintertime? Insects cannot maintain their own body temperatures the way people do. They depend on the environment to keep them warm. If they get too cold, they can die. Some butterflies that live in areas with regular seasons, like Pennsylvania, cannot tolerate very cold weather. Such species can only survive the winter by leaving, flying to a warmer location until spring returns. This is called migration.

One of the most incredible migrations is made by Monarch butterflies. In fact, migrating Monarchs are remarkable in several ways. Most adult butterflies – including most Monarchs - live an average of only about four weeks. However, once every year, a special, migratory generation of Monarchs develops. This generation, hatching near the end of summer, will have an unusually long life span. Unlike their parents, grandparents, and great-grandparents, these migratory Monarch butterflies can live up to nine months. To put this in human terms, assuming an average person's life span is 75 years, this would be like having certain generations who could live to be over 650 years old!

Every year, many millions of Monarch butterflies throughout the United States and Canada migrate south for the winter. The butterflies that live west of the Rocky Mountains travel to the southern California coast. Most monarchs that live east of the Rockies fly all the way to the center of Mexico, where they rest all winter long. These same butterflies begin to migrate north again the next spring, but they breed and die along the way. The journey home is continued by the next few generations of adults, each of which lives only four or five weeks. The group of Monarchs that flies south again the following winter is several generations removed and has never migrated before. It is still a mystery to scientists how these butterflies manage to make their way to the exact same winter sites every year without having been there before.

The scientific name for the Monarch butterfly is *Danaus plexippus*. This name is inspired by a Greek myth about the king Danaus, ruler of Libya. Danaus fled to Greece with his 50 daughters, the Danaids, after fighting with his brother Aegyptus, the ruler of Egypt. Aegyptus wanted his 50 sons to marry the Danaids and sent them in pursuit of the women. The lengthy migration of millions of Monarch butterflies calls to mind the long flight of Danaus and his many daughters.

**Math Activity**

Reread the second paragraph carefully. Create a mathematics equation to explain why “in human terms” the butterflies would be over 650 years old. Be sure to show all of your work and calculations.

Reread the first four sentences of the third paragraph to determine where a Monarch from Philadelphia spends the winter. Now look at a map of North America and locate that area. Calculate the approximate distance a butterfly from Philadelphia has to migrate.

If this same butterfly makes it one-quarter of the way back north in the spring before dying, about how many miles does it fly?

**Strategy 2: Diapause (hibernating)**

Have you ever wondered where all the insects go when it gets cold? It may seem that they have disappeared, but they are often still around. You may just not see where they are hiding.

Insects cannot maintain their own body temperatures the way people do. They depend on the environment to keep them warm. If they get too cold, they can die. Butterflies that live year-round in areas with regular seasons, like Pennsylvania, have to face winter. Such butterfly species are able to survive the cold only by entering diapause.

Diapause is a period of dormancy, or hibernation, during which all development and activity stops. During diapause, a butterfly's metabolism slows down and chemicals may be produced that prevent it from freezing. The reduced length of daylight that happens as winter approaches often triggers diapause. The butterfly remains inactive, without growing, eating, moving, or changing, until days get longer and temperatures return to suitable levels. In some habitats, like the Arctic, the warm seasons can be so short that it may take several years for a butterfly to complete its life cycle.

Depending on the species, butterflies can hibernate at any stage of their life cycle. The stage in which a butterfly spends the winter is called the overwintering stage. A few species hibernate as adults, such as the Mourning Cloak butterfly, or as eggs. However, most butterflies overwinter as caterpillars or pupae. They spend diapause in sheltered places, such as in wood piles or tree holes, under leaf litter or loose bark, and inside cool, quiet buildings.

Butterflies sometimes wake up during the winter if there are some unusually warm days, or if they have been in a cold building that is suddenly heated. If they stay active for too long, though, they can use up their food reserves and die, since their food plants are not growing then. If you find them flying in your home, move them to a colder spot, like a garage or tool shed, until winter passes. In the spring, butterflies pick up where they left off: eggs hatch, caterpillars resume eating, pupae transform, and adults fly and feed from the newly blooming flowers.

**Math Activity**

Would a butterfly be in diapause if the temperature were 85 degrees Fahrenheit outside?

What do you think would happen to a butterfly if the temperature dropped by 30 degrees Fahrenheit?

Chart the average temperatures over twelve months in your community. Use a T-Chart to show the months during which butterflies would most likely be in diapause.

Based on the information below, answer the question that follows. Be sure to show all of your work and calculations:

An average butterfly in Florida lives in the caterpillar stage for about six weeks.

Because of short summers, a butterfly in the Arctic spends a lot of time in diapause as a caterpillar. This caterpillar stage lasts about a year and a half.

Question: How many times longer does the Arctic caterpillar live than the Florida caterpillar?

**Jigsaw Reading Activity**

- 1.) You will only have \_\_\_\_ minutes to complete your reading poster.
- 2.) In your group, read your handout and discuss the most important facts.
- 3.) Your group will record the most important facts on chart paper and will report out to the entire class.
- 4.) Complete the math activity and use your chart to show your results.
- 5.) Please read the roles below and sign your name under the role that you will fulfill.

**Jigsaw Reading Activity Roles and Responsibilities**

**Reader** Responsibilities:

- You will read the handout aloud to your group.
- You will ensure that all group members can hear you.
- You will reread the handout as necessary.

\_\_\_\_\_  
Student Name

**Observer** Responsibilities:

- You will alert your group to specific ideas and details that are important.
- You will ensure your ideas are recorded properly.

\_\_\_\_\_  
Student Name

\_\_\_\_\_  
Student Name

\_\_\_\_\_  
Student Name

**Recorder** Responsibilities:

- You will record your group’s ideas.
- You will take notes on scrap paper and confirm the accuracy of your notes with your group.
- You will transfer your notes to the chart paper.

\_\_\_\_\_  
Student Name

**Presenter** Responsibilities:

- You will present your group’s informational chart to the class.

\_\_\_\_\_  
Student Name

## Rubric 4.3 for Student Handout 4.3/Informational Chart    Life Cycles/Winter Strategies

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	2 – Approaching Standards	1 – Below Standards	Score
<b><u>Use of Class Time</u></b>	Used time well during each class period. Focused on getting the project done. Never distracted others or themselves.	Used time well during each class period. Usually focused on getting the project done and never distracted others.	Used some of the time well during each class period. There was some focus on getting the project done but occasionally distracted others.	Did not use class time to focus on the project OR often distracted others.	
<b><u>Required Elements</u></b>	The poster includes all required elements as well as additional information.	All required elements are included on the poster.	All but 1 of the required elements are included on the poster.	Several required elements were missing.	
<b><u>Content - Accuracy</u></b>	At least 7 accurate facts are displayed on the poster.	5-6 accurate facts are displayed on the poster.	3-4 accurate facts are displayed on the poster.	Less than 3 accurate facts are displayed on the poster.	
<b><u>Grammar</u></b>	There are no grammatical mistakes on the poster.	There is 1 grammatical mistake on the poster.	There are 2 grammatical mistakes on the poster.	There are more than 2 grammatical mistakes on the poster.	
<b><u>Knowledge Gained</u></b>	Student can accurately answer all questions related to facts in the poster and processes used to create the poster.	Student can accurately answer most questions related to facts in the poster and processes used to create the poster.	Student can accurately answer about 75% of questions related to facts in the poster and processes used to create the poster.	Student appears to have insufficient knowledge about the facts or processes used in the poster.	



# Rubric 4.R Butterfly Flyer Reflection Piece

# Life Cycles/Winter Strategies

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	2 – Approaching Standards	1 – Below Standards	Score
<b><u>Use of Class Time</u></b>	Used time well during each class period. Focused on getting the project done. Never distracted others.	Used time well during each class period. Usually focused on getting the project done and never distracted others.	Used some of the time well during each class period. There was some focus on getting the project done but occasionally distracted others.	Did not use class time to focus on the project OR often distracted others.	
<b><u>Graphics - Relevance</u></b>	All graphics are related to the topic and make it easier to understand. All borrowed graphics have a source citation.	All graphics are related to the topic and most make it easier to understand. All borrowed graphics have a source citation.	All graphics relate to the topic. Most borrowed graphics have a source citation.	Graphics do not relate to the topic OR several borrowed graphics do not have a source citation.	
<b><u>Knowledge Gained</u></b>	Student can accurately answer all questions related to facts in the poster and processes used to create the poster.	Student can accurately answer most questions related to facts in the poster and processes used to create the poster.	Student can accurately answer about 75% of questions related to facts in the poster and processes used to create the poster.	Student appears to have insufficient knowledge about the facts or processes used in the poster.	
<b><u>Content - Accuracy</u></b>	At least 6 accurate facts are displayed on the poster.	5 accurate facts are displayed on the poster.	3-4 accurate facts are displayed on the poster.	Less than 3 accurate facts are displayed on the poster.	

**Target:** 5<sup>th</sup>-8<sup>th</sup> Grade

**Duration:** One 45-minute lesson w/ extension options and parent links

**Discipline Connections:** Science, English, Visual Arts, Technology, Geography, Math, Social Studies

**Before the Lesson/ Materials:** Copies of Student Handout 5.1, Student Handout 5.2 (optional), and Rubrics 5.1, 5.2 (optional), and 5.R for each student; sample flowers

**Word Bank:** Habitat, Pollination, Host Plant, Nectar, Nectar Plant, Symbiotic Relationship

**Objective:** Students will demonstrate their understanding of a butterfly habitat. They will learn specifically about how adult butterflies and caterpillars need plants and how plants need butterflies and caterpillars.

**Background:** In this activity, students will learn that butterflies need an appropriate habitat. Butterflies and plants have a symbiotic, or mutually beneficial, relationship. Host plants provide caterpillars with necessary food and adult butterflies with an appropriate place to lay eggs. Nectar plants provide butterflies with energy. Caterpillars help plants grow by recycling nutrients and making them available, and butterflies help plants reproduce through pollination.

**Focusing Question:** What is a habitat? Describe your habitat.

**Procedure:**

1. Distribute Student Handout 5.1 and Rubric 5.1.
2. Have students respond in writing to the focusing question and select a few students to share highlights from their responses.
3. State the lesson's objective and write the objective on the board.
4. Discuss with the class the requirements of any habitat: food, water, shelter, space.
5. Have students brainstorm aloud how their habitat provides them with food, water, shelter, and space.
6. Have students work with a partner to brainstorm in writing how a butterfly's habitat provides it with food, water, shelter, and space.
7. Have students share their ideas with the class. Make sure to clarify any misconceptions about habitat and provide any necessary information.
8. Describe the basic parts of a flower and their functions. Have students take notes on their handouts. A sample flower would be helpful for this demonstration.
9. Describe the process of pollination and how butterflies help pollinate flowers. Have students take notes on their handouts.
10. Describe a symbiotic relationship and how plants and butterflies help each other. Have students take notes on their handouts.

**Museum Activities (optional):**

1. At the Academy's *Butterflies!* exhibit, students will explore the different habitat requirements for a butterfly.
2. Distribute Student Handout 5.2 and Rubric 5.2.

3. **Optional:** Participate in a nectar extraction lab at the Academy (a fee-based lesson). Students will use equipment to acquire and measure the sugar concentration in the nectar of various flowers. Call the Academy registrar to reserve a lesson at 215-299-1060.

### **Reflection:**

Have students write a paragraph about the symbiotic relationship between plants and butterflies. They should describe how plants help butterflies and caterpillars and how butterflies and caterpillars help plants. Distribute Rubric 5.R.

**Assessment:** Completed Student Handout 5.1, Student Handout 5.2, and Reflection Paragraph

### **Lesson Adaptations:**

- Teacher may use an overhead to display information if student note-taking for Student Handout 5.1 is too time consuming, or teacher may copy the Answer Key for Handout 5.1 for reference by students.

### **Extension Options:**

- Go outside and have students select a living organism to observe. You can go into the school yard, field, or other natural area. Have them describe the habitat of this organism in their journal.
- Have students choose two different habitats that they have experienced. Have them write a paragraph comparing and contrasting these habitats and draw an illustration of each habitat.
- Using the library or Internet resources, have students research one type of butterfly and its habitat. Students should learn about the climate, required host plants, nectar plants available, and other habitat descriptors. Have students pretend to be the butterfly and send back a travel brochure to a family member describing the habitat that the butterfly has visited. Travel brochure should include descriptions and illustrations. Travel brochure resource: [http://www.readwritethink.org/lessons/lesson\\_view.asp?id=961](http://www.readwritethink.org/lessons/lesson_view.asp?id=961)  
Butterfly and larval food plants resource: <http://mamba.bio.uci.edu/~pjbryant/biodiv/bflyplnt.htm>
- Have students create a teaching poster with a diagram of the different parts of a flower and have them use the poster to teach other students from different classes. Students may bring in live flowers for demonstration. Students should describe how butterflies help flowers.
- Have students create cards of different animals that live in different habitats. You may restrict them to a certain type of habitat or a certain class of organisms. Collect all cards and play “Who am I?” game by attaching with a clothespin one picture of an animal to a student’s back without the student looking at the picture. The goal is for the student to figure out what animal is on her/ his back by asking only **yes** or **no** questions about the mystery organism’s habitat. For example, “Does my animal live in an aquatic habitat?” “Does my animal fly around to find its food?” “Does my animal live underground?” Students should ask at least five questions before guessing what animal they have.

### **Parent-Links:**

- Select various different flowering plants and have students dissect flowers. Students should identify all flower parts discussed in class. Students may use glue or tape to affix the flower parts to a piece of construction paper. Day lilies, roses, tulips, or honeysuckle work well.

- Have students explore different habitats in their neighborhoods. For example, they could compare the habitat in a park to a downtown city area to a suburban area.
- Have each student write a letter to a pen pal living in a different part of the country or the world describing her/his habitat, focusing on climate, plants and animals.

**Resources:**

- [http://www.readwritethink.org/lessons/lesson\\_view.asp?id=961](http://www.readwritethink.org/lessons/lesson_view.asp?id=961)
- <http://webinstituteformeachers.org/99/teams/pizza/flowers.htm>
- <http://mamba.bio.uci.edu/~pjbryant/biodiv/bflyplnt.htm>

**Standards:**

***Philadelphia City Standards:*** Reading 1,2,3; Writing 1,2,3; Speaking 1; Listening 1; Social Studies 3; Science 1,2,3,5,6; Math 1,6; Arts 1,7

***Pennsylvania State Standards:*** Reading, Writing, Speaking, Listening 1.1,1.2,1.4,1.5,1.6,1.8; Geography 7.1A-B, 7.2 A-B, 7.4A-B; Science and Technology 3.1A and E, 3.2 C,3.3A-B, 3.5B, 3.6B, 3.7 C,E, 3.8C; Family and Consumer Sciences 11.2H; Math 2.3, 2.5, 2.6; Art 9.1 B, I, J, and K, Environment and Ecology 4.5A, 4.7B; Civics and Government 5.2F

Name: \_\_\_\_\_

Date: \_\_\_\_\_

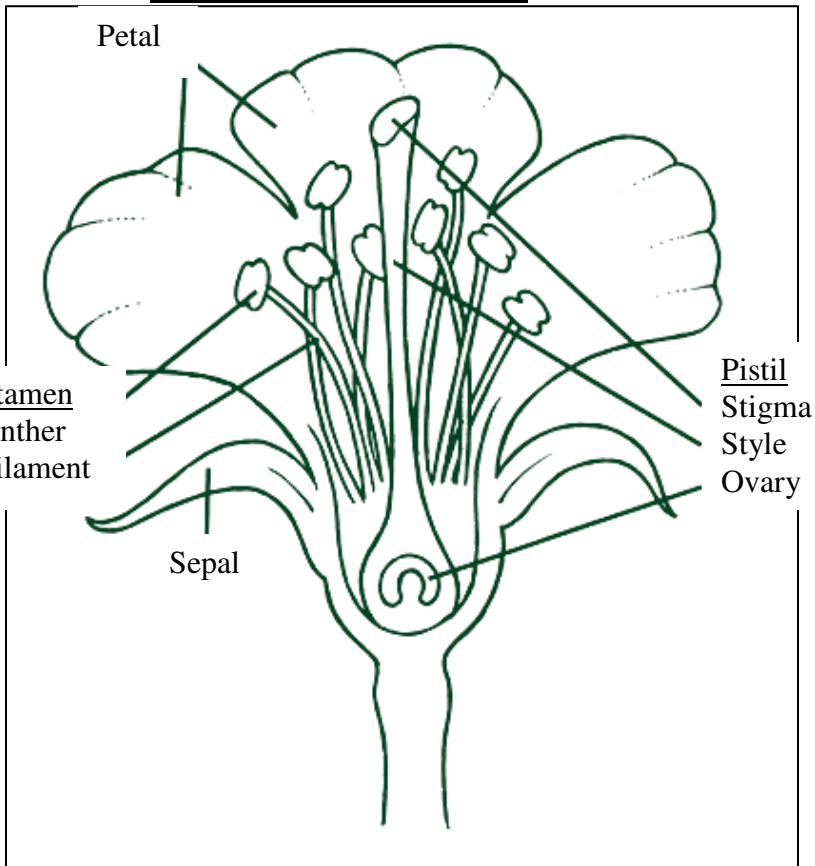
Focusing Question:

What is a habitat? Describe your habitat.

What are the requirements of any habitat? Describe each of these requirements for an adult butterfly.

- 1.
- 2.
- 3.
- 4.

**Parts of a flower**



Parts of a flower and their functions:

- 1. Petal \_\_\_\_\_
- 2. Sepal \_\_\_\_\_
- 3. Stamen \_\_\_\_\_
  - a. anther \_\_\_\_\_
  - b. filament \_\_\_\_\_
- 4. Pistil \_\_\_\_\_
  - a. Stigma \_\_\_\_\_
  - b. Style \_\_\_\_\_
  - c. Ovary \_\_\_\_\_

1) What is pollination? How do butterflies help flowers?

2) What is a symbiotic relationship?

3) How do plants help caterpillars?

4) How do plants help adult butterflies?

5) How do caterpillars help plants?

6) How do adult butterflies help plants?

Focusing Question:

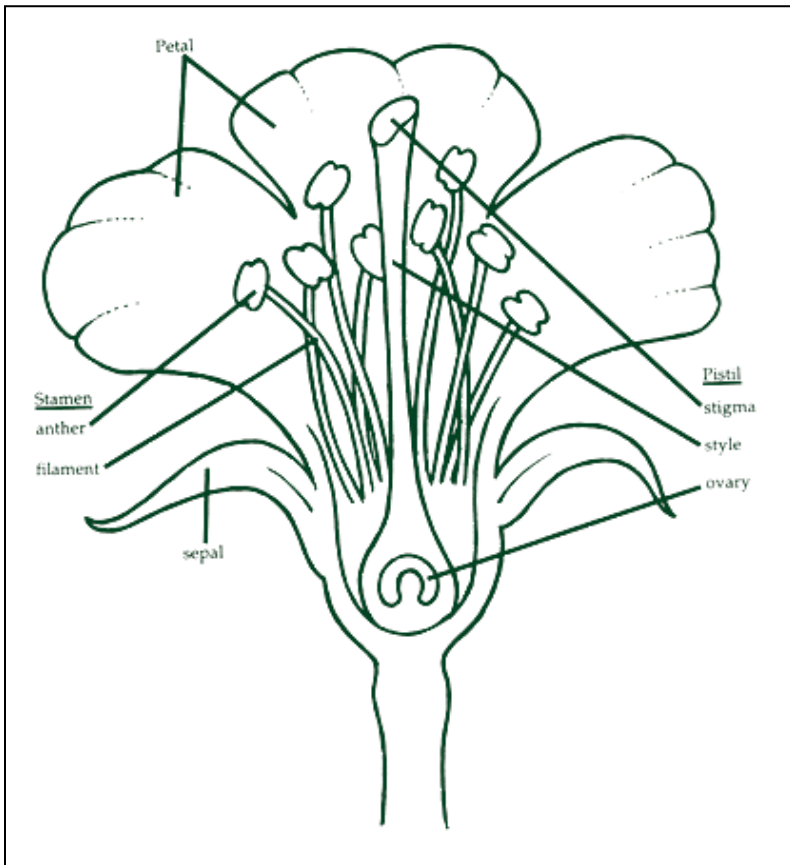
What is a habitat? Describe your habitat.

Answers will vary.

What are the requirements of any habitat? Describe each of these requirements for a butterfly.

1. *Food- adult butterflies need a variety of flowering plants from which to drink nectar (these are called **nectar plants**), caterpillars need specific **host plants** to eat, therefore adult butterflies need to lay their eggs on these host plants*
2. *Water- adult butterflies mostly obtain moisture (and minerals) from mud puddles, wet sand, sap, dung, decomposing animals and fruit, and their main food (nectar); Caterpillars also get enough water from their food.*
3. *Shelter- butterflies are cold blooded, they need resting areas exposed to the sun so they can stay warm, they need trees, shrubs, and other protective areas to shelter them from wind and rain.*
4. *Space- need a large enough habitat to fly around and meet all requirements*

Parts of a flower



Parts of a flower and their functions:

5. Petal- *colorful to attract pollinators like butterflies*
6. Sepal- *protects and holds up the petals*
7. Stamen- *male part of flower, makes the pollen (male sex cell)*
  - a. Anther- *holds the pollen*
  - b. Filament- *holds up the anther so that pollinators can carry pollen away*
8. Pistil- *female part of flower, makes the eggs (female sex cell)*
  - a. Stigma- *sticky to catch pollen*
  - b. Style- *holds up the stigma*
  - c. Ovary- *holds the egg*

1) What is pollination? How do butterflies help pollinate flowers?

*Pollination is the way in which flowers reproduce. Pollen from the anther (male part of flower) needs to be transported to the stigma (female part of the flower). When pollen travels down the style it fertilizes the egg in the ovaries to form a baby seed. Some pollen travels by wind, but some plants require animals to move the pollen.*

2) What is a symbiotic relationship?

*A close, prolonged association between two or more organisms of different species that benefits one or both members; butterflies and plants have a mutually beneficial relationship*

3) How do plants help caterpillars?

*Plants (mostly leaves) provide food for caterpillars. Most caterpillars rely on very specific species of plants for food; these are called host plants.*

4) How do plants help adult butterflies?

*Plants provide food for adult butterflies in the form of nectar; these are called nectar plants. Host plants provide a place for adults to lay their eggs.*

5) How do caterpillars help plants?

*Caterpillars eat and digest leaves and deposit wastes; this recycles nutrients and makes them available for other plants and animals to use.*

6) How do adult butterflies help plants?

*Butterflies transfer pollen from one plant to another as they visit different flowers to get nectar, helping plants reproduce and survive.*



## Rubric 5.1 for Student Handout 5.1

## Habitats/Plants

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	2 – Approaching Standards	1 – Below Standards	Score
<b><u>Answers</u></b>	All of the answers are clearly supported with specific examples that are relevant to the question.	Most of the answers are clearly supported with specific examples that are relevant to the question.	At least two of the answers are clearly supported with specific examples that are relevant to the question.	Answers are not clearly supported with specific examples and/or are not relevant to the question.	
<b><u>Accuracy</u></b>	All supportive facts are reported accurately.	Almost all supportive facts are reported accurately.	Most supportive facts are reported accurately.	Most supportive facts are inaccurately reported.	
<b><u>Sentence Structure</u></b>	All sentences are well-constructed with varied structure.	Most sentences are well-constructed and there is some varied sentence structure.	Most sentences are well constructed, but there is no variation in structure.	Most sentences are not well-constructed or varied.	
<b><u>Grammar &amp; Spelling</u></b>	Author makes no errors in grammar or spelling that distract the reader from the content.	Author makes 1-2 errors in grammar or spelling that distract the reader from the content.	Author makes 3-4 errors in grammar or spelling that distract the reader from the content.	Author makes more than 4 errors in grammar or spelling that distract the reader from the content.	

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Describe the butterfly habitat that you observe at the Academy's *Butterflies!* exhibit.

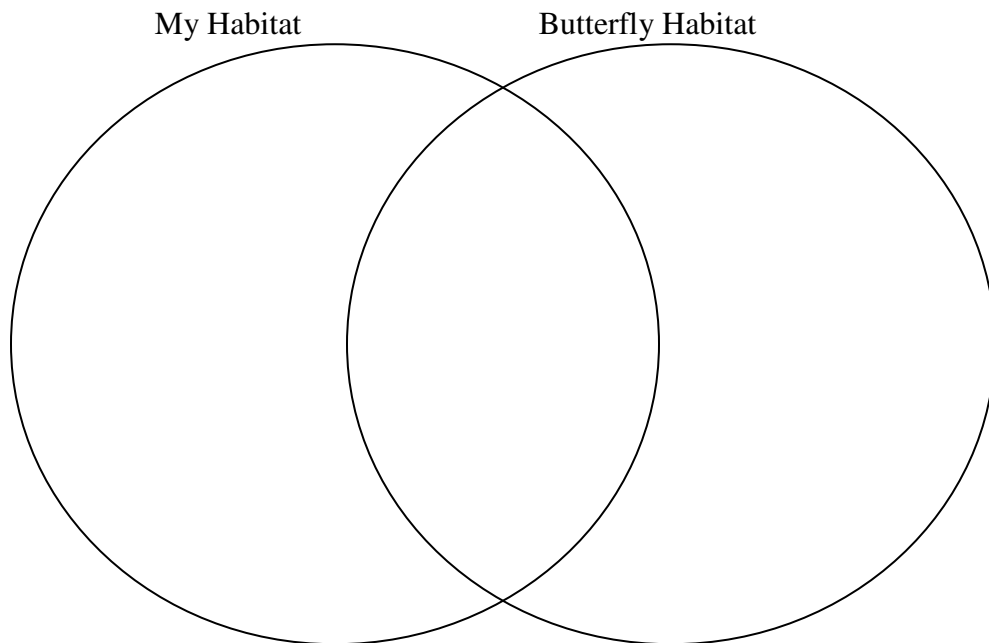
Do you see any adult butterflies in the conservatory (butterfly garden)? What are they doing in their habitat? Do you see any caterpillars? What are they doing in their habitat?

Do you see any butterflies or caterpillars eating? Describe what you see.

Do you see any butterflies or caterpillars drinking? Describe what you see.

Do you see any butterflies chasing each other? Why do you think this is?

Compare and contrast your own habitat to the butterfly habitat using a Venn diagram. Remember that the similarities between the two habitats are written where both circles meet and the differences go on either side of the meeting place.



Describe the butterfly habitat that you observe at the Academy's *Butterflies!* exhibit.  
*Answers will vary. The room is approximately 80 °F with 80% humidity.*

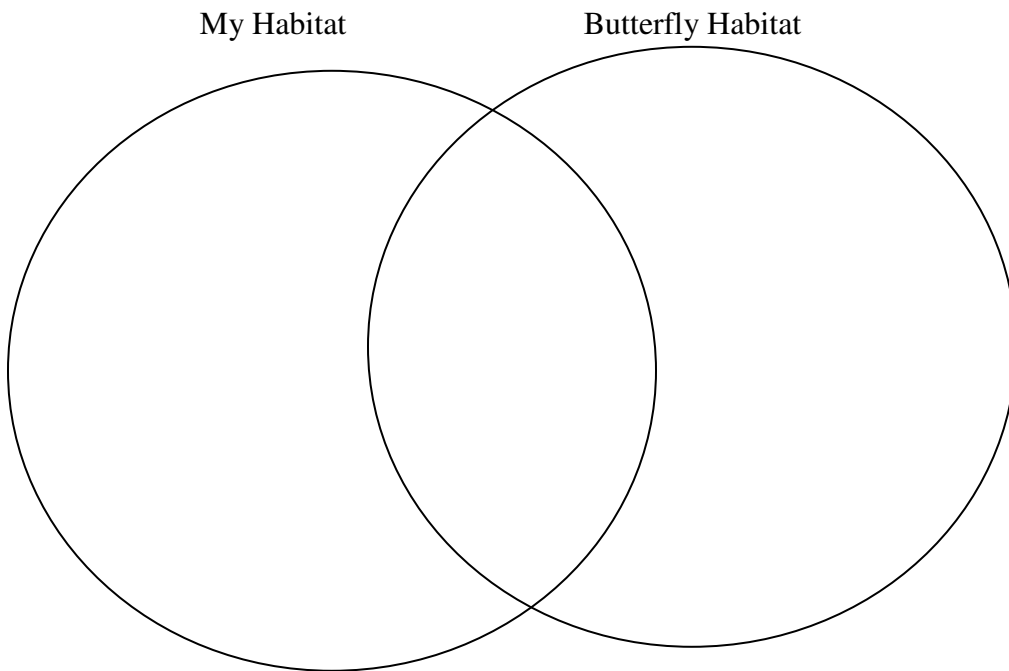
Do you see any adult butterflies in the conservatory (butterfly garden)? What are they doing in their habitat? Do you see any caterpillars? What are they doing in their habitat?  
*Answers will vary. They may be resting, flying, eating (drinking), chasing each other, mating.*

Do you see any butterflies or caterpillars eating? Describe what you see.  
*Answers will vary.*

Do you see any butterflies or caterpillars drinking? Describe what you see.  
*Answers will vary.*

Do you see any butterflies chasing each other? Why do you think this is?  
*Answers will vary.*

Compare and contrast your own habitat to the butterfly habitat using a Venn diagram. Remember that the similarities between the two habitats are written where both circles meet and the differences go on either side of the meeting place.  
*Answers will vary.*



**Nectar Lab at the Academy:**

Optional, fee-based activity in which students extract nectar from flowers. Contact the Registrar's Office to reserve a lesson.

## Rubric 5.2 for Student Handout 5.2

## Habitats/Plants

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	2 – Approaching Standards	1 – Below Standards	Score
<b><u>Answers</u></b>	All of the answers are clearly supported with specific examples that are relevant to the question.	Most of the answers are clearly supported with specific examples that are relevant to the question.	At least two of the answers are clearly supported with specific examples that are relevant to the question.	Answers are not clearly supported with specific examples and/or are not relevant to the question.	
<b><u>Accuracy</u></b>	All supportive facts are reported accurately.	Almost all supportive facts are reported accurately.	Most supportive facts are reported accurately.	Most supportive facts are inaccurately reported.	
<b><u>Sentence Structure</u></b>	All sentences are well-constructed with varied structure.	Most sentences are well-constructed and there is some varied sentence structure.	Most sentences are well constructed, but there is no variation in structure.	Most sentences are not well-constructed or varied.	
<b><u>Grammar &amp; Spelling</u></b>	Author makes no errors in grammar or spelling that distract the reader from the content.	Author makes 1-2 errors in grammar or spelling that distract the reader from the content.	Author makes 3-4 errors in grammar or spelling that distract the reader from the content.	Author makes more than 4 errors in grammar or spelling that distract the reader from the content.	

## Rubric 5.R for Reflection Paragraph

## Habitats/Plants

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	3 – Meets Standards	1 – Below Standards	Score
<b><u>Focus or Thesis Statement</u></b>	The thesis statement names the topic of the paragraph and outlines the main points to be discussed.	The thesis statement names the topic of the paragraph.	The thesis statement outlines some or all of the main points to be discussed but does not name the topic.	The thesis statement does not name the topic AND does not preview what will be discussed.	
<b><u>Accuracy</u></b>	All supportive facts are reported accurately.	Almost all supportive facts are reported accurately.	Most supportive facts are reported accurately.	Most supportive facts are inaccurately reported.	
<b><u>Sentence Structure</u></b>	All sentences are well-constructed with varied structure.	Most sentences are well-constructed and there is some varied sentence structure.	Most sentences are well constructed, but there is no variation in structure.	Most sentences are not well-constructed or varied.	
<b><u>Grammar &amp; Spelling</u></b>	Author makes no errors in grammar or spelling that distract the reader from the content.	Author makes 1-2 errors in grammar or spelling that distract the reader from the content.	Author makes 3-4 errors in grammar or spelling that distract the reader from the content.	Author makes more than 4 errors in grammar or spelling that distract the reader from the content.	

## Lesson #6

## Theme: Habitats

## Topic: Plants

**Target:** 5-8<sup>th</sup> Grade

**Duration:** One 45-minute lesson w/extension options and parent links

**Discipline Connections:** Science, Math, English, Visual Arts, Technology, Geography

**Before Lesson/Materials:** Copies of Student Handouts 6.1, 6.2, 6.3 (or blank map), and 6.4 and Rubrics 6.4 and 6.R for each student; one atlas per two students or a copy of the state map

**Word Bank:** Proboscis, Habitat, Host Plant, Nectar, Nectar Plant

**Objective:** Students will demonstrate their ability to identify features of butterfly and caterpillar habitats. Students will be able to differentiate the host plant needs of different species of butterflies.

**Background:** In this lesson, students will create their own habitats using a list of supplied specifications for different species of butterflies. Students will work cooperatively to complete an inquiry-based activity designed by their classmates.

**Focusing Question:** All living organisms need certain things in their environment to keep them alive. Brainstorm a list of things that you need in your environment to survive. Now cross three things off of your list. What would happen to you if those three things did not exist? Write to explain what would happen.

### **Procedure:**

1. Have students respond in writing to the focusing question. Select a few students to share highlights from their responses.
2. Explain that students will learn about the habitats of different types of butterflies and caterpillars.
3. State the lesson's objective and write the objective on the board.
4. Distribute Student Handout 6.1.
5. Pair students off and have them take turns reading the handout to each other (if you have students that are significantly below level, use this handout as a Shared Reading<sup>1</sup>).
6. Distribute Student Handouts 6.2, 6.3, and 6.4, Rubric 6.4, and atlases. **Students should remain with their partners.**
7. Have students use the atlas and Student Handout 6.2 to fill in all of the states and ranges on their blank map (Student Handout 6.3).
8. Read all directions from Handout 6.4 and answer questions. Allow students time to conduct part one of the activity following all of the directions on Handout 6.4.
9. Have students complete the second part of Handout 6.4 and switch papers with another partner group.

**Reflection:** Ask students to create a three-part chart to show what types of plants butterflies need to survive. Label the three columns: Butterfly, Host Plant for caterpillar, and Nectar Plant for butterfly. Distribute Rubric 6.R.

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<sup>1</sup> During a Shared Reading the teacher reads the text aloud while the students follow along. The teacher models good reading strategies and may pause to ask questions to ensure student engagement.

**Assessment:** Completed Student Handout 6.3, Student Handout 6.4, three-part chart

**Adaptations:** In order to save time, students can be given maps that are already labeled with states and regions. This strategy would also work well with students that need additional scaffolding.

**Extension Options:**

- Read the book entitled Kids' Easy-to-Create Wildlife Habitats: For Small Spaces in City-Suburbs-Countryside (Quick Starts for Kids!) (Paperback) by Emily Stetson, J. Susan Cole Stone (Illustrator) (published by Williamson Books, ISBN #0824986652). Have the students create a list of materials and a plan to build their own habitat.
- Have students create their own maps for several species of butterflies and their habitats using a blank state map. Have them look at the following site, which contains an interactive map that shows where different types of butterflies live:  
<http://butterfliesandmoths.org/map>
- Have students create a teaching poster, which includes a chart of what different butterflies use as food plants. Then have the students create a matching game using index cards. They should write the plant name on one card and the butterfly or caterpillar that feeds on that host or nectar plant on a separate card. The students should take the cards and their reference poster to another class and have other students play the matching game.

**Parent-Links:**

- Build a caterpillar habitat using household objects. Find out how at:  
<http://en.arocho.org/usakids/index8.html>
- Go on a butterfly/caterpillar expedition. Look for local specimens and record their types, host plants, and habitats.
- Take photos of the butterfly/caterpillar. Create a map of your community and place the photos on the map where you had the butterfly sightings.

**Resources:**

- <http://en.arocho.org/usakids/index8.html>
- <http://butterfliesandmoths.org/map>
- [http://www.foremostbutterflies.com/learn\\_about\\_butterflies/butterfly\\_habitat.htm](http://www.foremostbutterflies.com/learn_about_butterflies/butterfly_habitat.htm)

**Standards:**

***Philadelphia City Standards:*** Reading 1, 2, 3; Writing 1, 2, 3; Speaking 1, Listening 1, Social Studies 3; Science 1, 2, 3, 5, 6; Math 1, 2, 6, 9; Art 1, 7

***Pennsylvania State Standards:*** Reading, Writing, Speaking, Listening 1.1, 1.2, 1.4, 1.5, 1.6, 1.8; Geography 7.1 A and B, 7.2 A and B, 7.4A and B; Science and Technology 3.1A and E, 3.3.A and B, 3.5B, 3.6B, 3.7C and E, 3.8 C; Family and Consumer Sciences 11.2H; Math 2.2, 2.3, 2.4, 2.5, 2.6; Art 9.1B, I, J, and K; Environment and Ecology 4.5A, 4.7B; Civics and Government 5.2F

**Background information on butterfly food**

Larval and adult butterflies rely on different plants for food. Adult butterflies have no teeth and do not eat solid food. They have a straw-like, sucking mouth part called a proboscis. They can only drink fluids, such as flower nectar, sap, or juice. Flowers that adult butterflies feed from are called nectar plants.

Larvae or caterpillars, on the other hand, have strong chewing mouth parts and feed mainly on leaves and stems. Most caterpillars are very particular about the plants they eat, called host plants. They use only a few specific plants, or even just one, and different species rely on different host plants. For instance, larvae of the Monarch butterfly feed only on milkweed; without this host plant, Monarchs cannot survive.

Adult butterflies usually lay eggs only on the correct host plant for their species. Therefore, in order to be able to support a certain type of butterfly, a habitat needs to provide food for both the adults and the larvae. Both host plants and nectar plants must be present.



## Student Handout 6.2

## Habitats/Plants

For the purpose of this activity, butterflies have been assigned specific nectar flowers. However, in reality, the adult butterflies may drink from other plants as well.

### **Butterfly Host Plant Index**

Scientific names have 2 parts and should be written in *italics*. The first word is called the **genus** and should always be capitalized, while the second part is the **species**, which is always written in lower-case. Adult butterflies get their food from **nectar plants** and caterpillars get their food from **host plants**.

(The following list was downloaded from <http://members.tripod.com/~CookingForFun/kids/butterfly.html>)

#### **Black Swallowtail (*Papilio polyxenes*)**

Nectar Flowers: Butterfly weed, phlox, clover, and thistle

Host Plants: Carrots, parsley, dill, and celery

Common Range: Southeast, Desert Southwest, Midwest, New England

#### **Tiger Swallowtail (*Papilio glaucus*)**

Nectar Flowers: Butterfly bush, lilac, honeysuckle, and butterfly weed

Host Plants: wild cherry, willow, cottonwood, and tulip-poplars

Common Range: Nationwide, except Pacific Coast

#### **Clouded Sulphur (*Colias philodice*)**

Nectar Flowers: Aster, goldenrod, phlox, and clover

Host Plants: Clover and alfalfa

Common Range: Nationwide, except Florida, Texas, and California

#### **Checkered White (*Pontia protodice*)**

Nectar Flowers: Aster, butterfly weed, and centaury

Host Plants: Mustard, turnips, cabbages, and bee-plant

Common Range: Nationwide, except for western Washington State

#### **Spring Azure (*Celastrina ladon*)**

Nectar Flowers: Aster, butterfly weed, and centaury

Host Plants: Dogwood, viburnum, New-Jersey-tea, and blueberry

Common Range: Nationwide, except for south and central Texas

#### **Gulf Fritillary (*Agraulis vanillae*)**

Nectar Flowers: Lantana, impatiens, shepherd's needle, and thistle

Host Plants: Passion vines

Common Range: Desert Southwest, Southeast, Wisconsin, California

#### **Pearl Crescent (*Phyciodes tharos*)**

Nectar Flowers: Thistle, aster, and gloriosa daisy

Host Plants: Aster

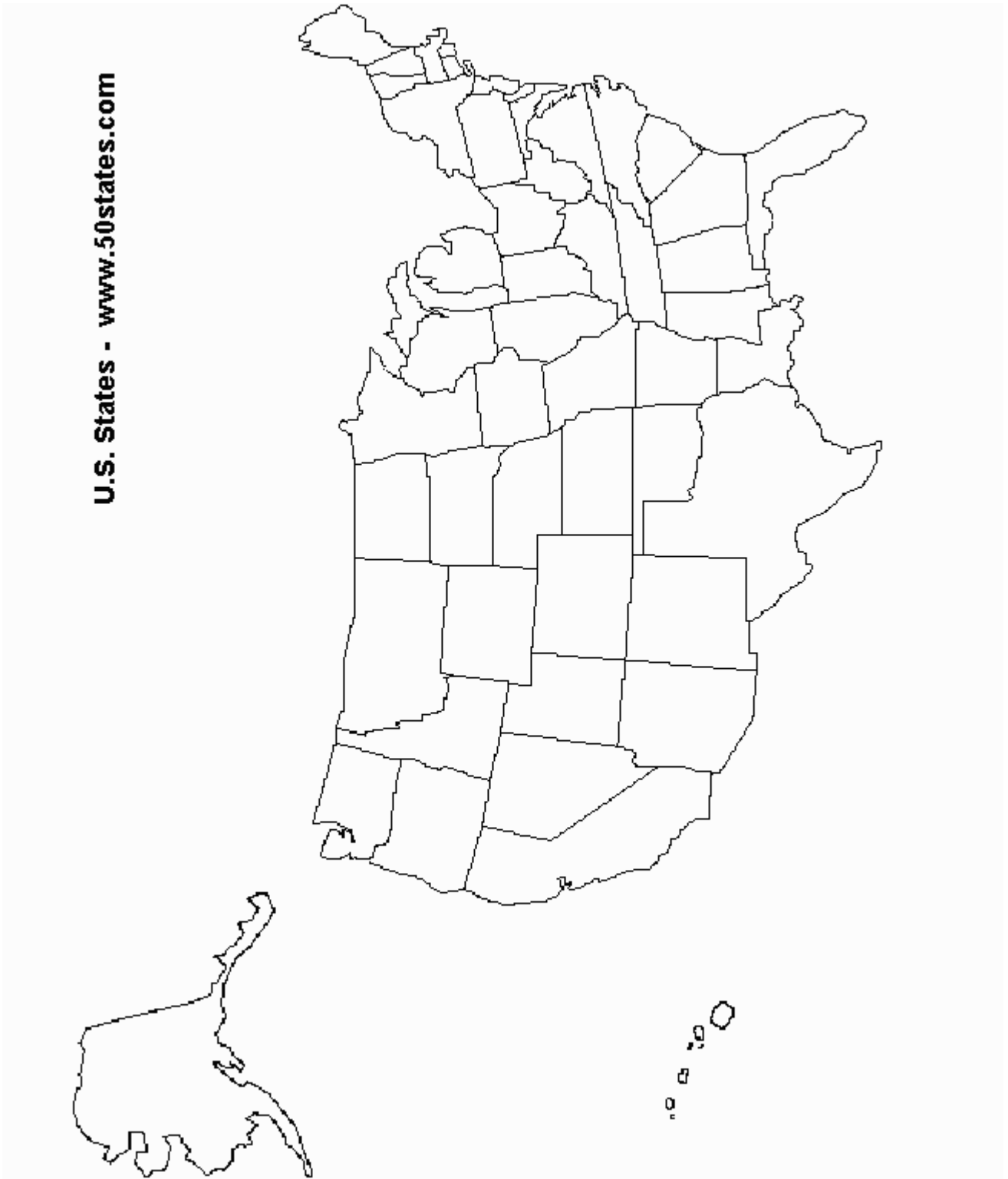
Common Range: Nationwide, except Pacific Coast

#### **Buckeye (*Junonia coenia*)**

Nectar Flowers: Aster, coreopsis, knapweed, and chicory

Host Plants: Plantain, snapdragon and toadflax

Common Range: Nationwide, except High Plains



### Build a Home for your Buddy the Butterfly

**Directions:** In this activity you will build a habitat for butterflies. You will use the Host Plant Index. Your goal is to support a minimum of three types of butterflies. **All of your host choices must be able to survive in your chosen habitat/range.** Check your spelling and fact accuracy. Good Luck!

**\*\*Note\*\*** Often butterflies will feed from a variety of nectar plants. For the purpose of this activity, please limit your choices to the nectar plants listed in the index.

#### Part One

1.) Write down three types of ranges that you want your butterflies to live in:

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2.) Write down 3 types of host plants for caterpillars:

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3.) Write down 3 types of nectar plants for butterflies:

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4.) List all of the butterflies that could live in your habitat: (minimum of three species)

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5.) Do you have at least three types of butterflies? Circle Yes or No

If not, you must change some of your answers to questions 1-3.

6.) Do you think that it would have been easier to select your butterflies first and then complete numbers 1-4? Why or why not? Explain your answer.

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**Part Two**

**Directions:** Use this paper to copy down your answers to questions 1-3. Give this paper to another partner team of students. See if you can figure out which butterflies could live in their habitat and if they can figure out which ones could live in yours.

HABITAT/RANGE:

\_\_\_\_\_

HOST PLANTS FOR CATERPILLARS:

\_\_\_\_\_

NECTAR PLANTS FOR BUTTERFLIES:

\_\_\_\_\_

BUTTERFLIES THAT WOULD EXIST: (minimum of three)

\_\_\_\_\_

\_\_\_\_\_

What challenges did you face when trying to figure out which butterflies could live in your habitat? How did you overcome those challenges? What surprised you about this activity? Write a paragraph to explain your experience.

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## Rubric 6.4 for Student Handout 6.4

## Habitats/Plants

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	2 – Approaching Standards	1 – Below Standards	Score
<b><u>Time Management</u></b>	Routinely uses time well throughout the project to ensure things get done on time. Group does not have to adjust deadlines or work responsibilities because of this person's procrastination.	Usually uses time well throughout the project, but may have procrastinated on one thing. Group does not have to adjust deadlines or work responsibilities because of this person's procrastination.	Tends to procrastinate, but always gets things done by the deadlines. Group does not have to adjust deadlines or work responsibilities because of this person's procrastination.	Rarely gets things done by the deadlines AND group has to adjust deadlines or work responsibilities because of this person's inadequate time management.	
<b><u>Problem Solving</u></b>	Actively looks for and suggests solutions to problems.	Refines solutions suggested by others.	Does not suggest or refine solutions, but is willing to try out solutions suggested by others.	Does not try to solve problems or help others solve problems. Lets others do the work.	
<b><u>Focus on the Task</u></b>	Consistently stays focused on the task and what needs to be done. Very self-directed.	Focuses on the task and what needs to be done most of the time. Other group members can count on this person.	Focuses on the task and what needs to be done some of the time. Other group members must sometimes nag, prod, and remind to keep this person on-task.	Rarely focuses on the task and what needs to be done. Lets others do the work.	
<b><u>Working with Others</u></b>	Almost always listens to, shares with, and supports the effort of partner. Tries to keep working well together.	Usually listens to, shares with, and supports the efforts of partner. Does not cause "waves" in the partnership.	Often listens to, shares with, and supports the efforts of partner, but sometimes is not a good team member.	Rarely listens to, shares with, and supports the efforts of partner. Often is not a good team player.	
<b><u>Quality of Work</u></b>	Provides work of the highest quality.	Provides high quality work.	Provides work that occasionally needs to be checked/redone by other group members to ensure quality.	Provides work that usually needs to be checked/redone by others to ensure quality.	

# Rubric 6.R for Three-Part Chart

# Habitats/Plants

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	2 – Approaching Standards	1 – Below Standards	Score
<b><u>Three-Column Chart</u></b>	The chart includes all required elements as well as additional information.	All required elements are included on the chart.	All but 1 of the required elements are included on the chart.	Several required elements were missing.	
<b><u>Content – Accuracy</u></b>	At least 6 accurate facts are displayed on the chart.	4-5 accurate facts are displayed on the chart.	3 accurate facts are displayed on the chart.	Less than 3 accurate facts are displayed on the chart.	
<b><u>Mechanics</u></b>	Capitalization and punctuation are correct throughout the chart.	There is 1 error in capitalization or punctuation.	There are 2 errors in capitalization or punctuation.	There are more than 2 errors in capitalization or punctuation.	
<b><u>Grammar</u></b>	There are no grammatical mistakes on the chart.	There is 1 grammatical mistake on the chart.	There are 2 grammatical mistakes on the chart.	There are more than 2 grammatical mistakes on the chart.	

**Target:** 5<sup>th</sup>-8<sup>th</sup> Grade

**Duration:** One 45-minute lesson w/ extension options and parent-links

**Discipline Connections:** Science, English, Social Studies, Math, Visual Arts, Technology, Geography

**Before the Lesson/ Materials:** Copies of Student Handouts 7.1, 7.2, and 7.3 (optional) and Rubrics 7.1, 7.3 (optional), and 7.R for each student; copies of Supplement 7.S (if necessary) for each student

**Word Bank:** Habitat, Threatened Species, Endangered Species, Extinct Species, Conservation

**Objective:** Students will demonstrate their understanding of the Regal Fritillary butterfly's habitat needs, reasons for the decline of this species, and ways to protect this butterfly's habitat. They will learn the definitions of threatened, endangered, and extinct species.

**Background:** In this activity, students will learn that butterflies have very specific habitat needs. The greatest worldwide threat to them is the ongoing loss or degradation of suitable habitat.

**Focusing Question:** What is a habitat? Describe your habitat. What are some things that you wouldn't be able to live without in your habitat?

**Procedure:**

1. Distribute Student Handouts 7.1 and 7.2 and Rubric 7.1.
2. Have students respond in writing to the focusing question and select a few students to share highlights from their responses.
3. State the lesson's objective and write the objective on the board.
4. Introduce new vocabulary. Review habitat needs and examples of threatened, endangered, and extinct species. (Butterflies, skippers, and moths listed under the Federal Endangered Species Act, along with their status, can be found at: [http://ecos.fws.gov/tess\\_public/SpeciesReport.do?groups=I&listingType=L](http://ecos.fws.gov/tess_public/SpeciesReport.do?groups=I&listingType=L))
5. Have students fill in the states on Student Handout 7.2 to assist them in answering Questions # 4-5. They may use an atlas to help them. *Teacher may instead label Student Handout 7.2 before class to save time.*
6. Have students read the article about one of Pennsylvania's endangered species, the Regal Fritillary, and answer the questions on the handout. The article can be found at the following website: <http://www.gpnc.org/regal.htm> (a copy is also included at the end of this lesson as Supplement 7.S, if you do not have computer access). If you have students that are significantly below level, use this handout as a Shared Reading.<sup>1</sup>
7. Choose students to share their answers to the questions.
8. Review the correct answers to the questions.

**Museum Activities (optional):**

9. At the Academy's *Butterflies!* exhibit, students will observe a butterfly habitat, evaluate different habitats, and learn about butterfly farming.
10. Distribute Student Handout 7.3 and Rubric 7.3.

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<sup>1</sup> During a Shared Reading, the teacher reads the text aloud while the students follow along. The teacher models good reading strategies and may pause to ask questions to ensure student engagement.

### **Reflection:**

Have students write two paragraphs about ways in which humans affect butterfly habitats. They should include ways in which humans threaten habitats and ways in which humans help or protect butterfly habitats. Distribute Rubric 7.R.

### **Assessment:**

Completed Student Handout 7.1, Student Handout 7.2, Student Handout 7.3, and Reflection Paragraph

### **Extension Options:**

- Have students read about the threatened habitat of another endangered species, the Karner Blue butterfly, at the following link:  
<http://dnr.wi.gov/org/caer/ce/ee/critter/insect/karner.htm>
- Have students participate in the following online lesson about butterfly farming, “From Butterflies to Buffaloes”:  
<http://www.econedlink.org/lessons/index.cfm?lesson=EM313&page=teacher>
- Have students use the Internet to research how human activity is affecting butterfly habitats.
- Have students use the Internet to research how global climate change is affecting butterfly habitats.
- Go to the Academy’s website to play “Butterflies and Climate Change”:  
<http://www.anasp.org/museum/butterflies/index.php>
- Have students write a letter to an organization devoted to the care and conservation of butterflies. Have students ask about suggestions on how they can help protect butterfly habitats. The Butterfly Conservation Initiative is a good place to start:  
[http://www.butterflyrecovery.org/butterfly\\_resources/](http://www.butterflyrecovery.org/butterfly_resources/)
- Have students do a research project on one of the endangered or threatened butterfly species on the Federal Endangered Species Act. They may present their work in oral presentations to the class. Species list at: [www.fws.gov/Endangered/esa.html](http://www.fws.gov/Endangered/esa.html)

### **Parent-Links:**

- Have students create their own butterfly garden. Butterfly gardens can be created in small flower beds, planters, vacant lots, or parks. Use the following tips:  
<http://www.nwf.org/backyardwildlifehabitat/attractbutterflies.cfm>  
The following website provides adult butterfly nectar preferences and larval food plants for caterpillars: <http://www.uky.edu/Ag/Entomology/entfacts/misc/ef006.htm>
- Have students create a butterfly guide of the butterflies that visit their butterfly garden or butterflies they see in their neighborhood. Students should keep a notebook containing a sketch of the butterfly, noting color, size, and any unique characteristics, and a sketch of the habitat, noting any significant flowers, plants, bodies of water, or shaded areas. Students can use a simple commercial field guide to identify the butterfly and any needed host plants. Students can organize their butterfly guide in any order they like (for example, according to type of habitat or color of butterfly).

### **Resources:**

- <http://www.econedlink.org/lessons/index.cfm?lesson=EM313&page=teacher>
- <http://www.nwf.org/backyardwildlifehabitat/attractbutterflies.cfm>
- <http://www.uky.edu/Ag/Entomology/entfacts/misc/ef006.htm>



- <http://dnr.wi.gov/org/caer/ce/eeek/critter/insect/karner.htm>
- <http://www.dcnr.state.pa.us/wrcf/define.aspx>
- <http://www.50states.com/maps/print/usamap.htm>
- [http://www.zoo.org/bflies\\_blms/cons.html](http://www.zoo.org/bflies_blms/cons.html)

**Standards:**

***Philadelphia City Standards:*** Reading 1,2,3; Writing 1,2,3; Speaking 1; Listening 1; Social Studies 2,3,4,6; Science 1,2,3,5,6,7; Math 1,6; Arts 1,7

***Pennsylvania State Standards:*** Reading, Writing, Speaking, Listening 1.1,1.2,1.4,1.5,1.6,1.8; Geography 7.1A-B, 7.2 A-B, 7.3D-E, 7.4A-B; Science and Technology 3.1A and E, 3.5B, 3.6B, 3.7 C,E, 3.8C; Family and Consumer Sciences 11.2C,11.2H; Math 2.4, 2.5, 2.6; Art 9.1 B, I, J, and K, Environment and Ecology 4.5A, 4.7B, 4.8C, 4.9A; Civics and Government 5.1A, C, J, and M, 5.2A, D, E, F, and G

Name: \_\_\_\_\_

Date: \_\_\_\_\_

**Focusing Question:**

What is a habitat? Describe your habitat. What are some things that you wouldn't be able to live without in your habitat?

**Vocabulary:**

Habitat- \_\_\_\_\_

Threatened Species- \_\_\_\_\_

Endangered Species- \_\_\_\_\_

Extinct Species- \_\_\_\_\_

Conservation- \_\_\_\_\_

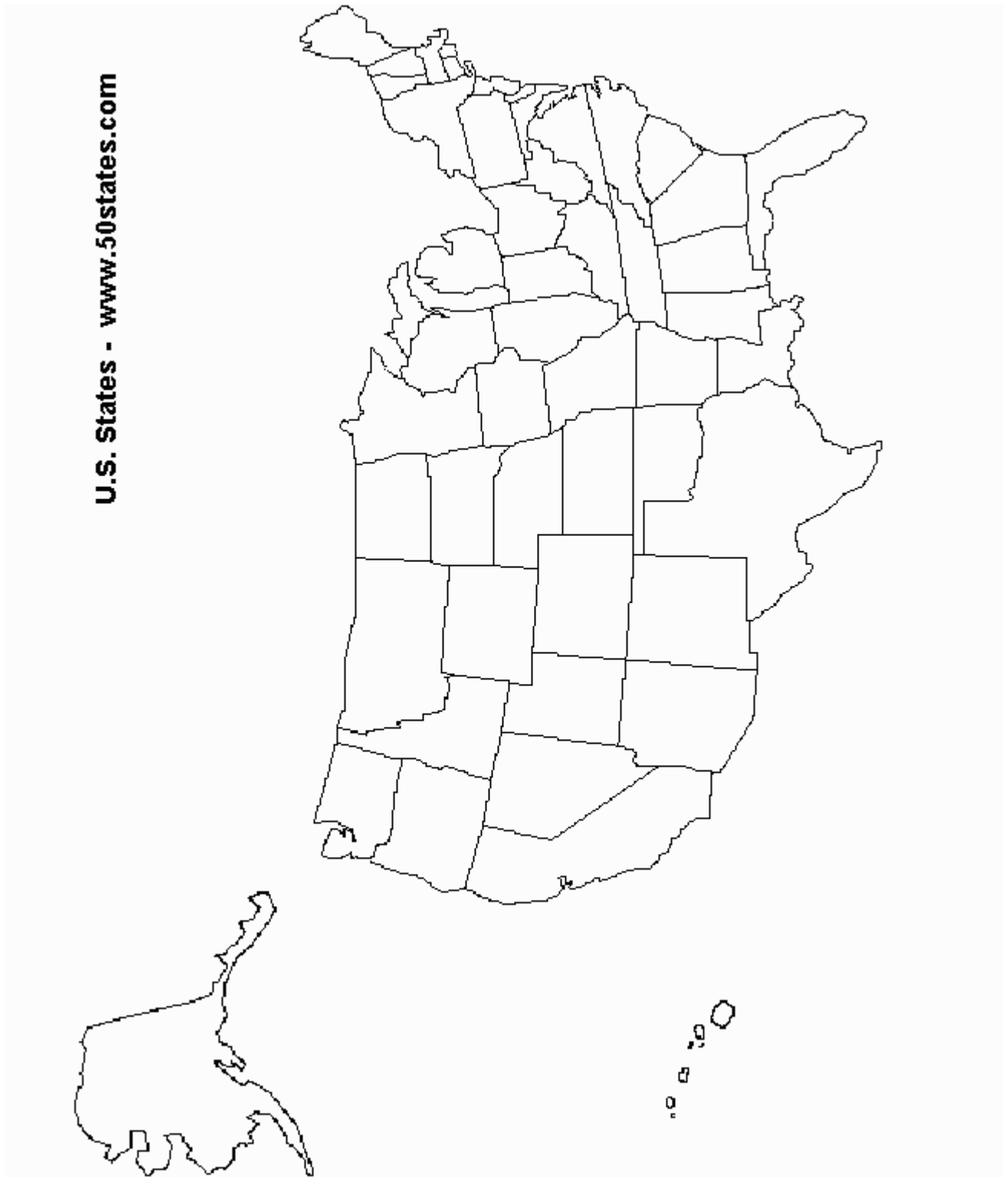
**Read the article about one of Pennsylvania's endangered butterflies, the Regal Fritillary at the following website: <http://www.gpnc.org/regal.htm>. Use the information in the article to answer the following questions.**

1. What is the scientific name of the Regal Fritillary? \_\_\_\_\_  
Scientific names have 2 parts. The first word is called the genus and is always capitalized, while the second part is the species, which is always written in lower-case. Sometimes, the subspecies is given as a third part; it is also always lower-case.

2. What plants do Regal Fritillary caterpillars eat? These are called the host plants.

3. When do the adult female butterflies lay their eggs? How do they survive the winter months?





**Focusing Question:**

What is a habitat? Describe your habitat. What is the one thing that you wouldn't be able to live without in your habitat?

*Answers will vary.*

**Vocabulary:**

Habitat- *the physical place in which an organism lives and where it can find food, water, shelter, and living space*

Threatened Species- *a species that may become endangered in the foreseeable future*

Endangered Species- *a species in imminent danger of extinction*

- *The Endangered Species Act provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found.*
- *22 butterfly species or subspecies and 2 moth species are currently listed as threatened or endangered under the Federal Endangered Species Act. Ex: Karner Blue butterfly and Mitchell's Satyr butterfly are considered endangered throughout their range*

Extinct Species- *a species that no longer exists*

- *Xerces Blue butterfly is the first butterfly known to become extinct in North America due to human activity, the coastal sand dunes of San Francisco where it lived were lost to urban development, last sightings in the wild were in the early 1940's*
- *Around 35 species of butterflies are thought to have gone extinct in the United States as a result of human activity during the past century*

Conservation-*the protection, preservation, management, or restoration of wildlife or other natural resources*

**Read the article about one of Pennsylvania's endangered butterflies, the Regal Fritillary, at the following website: <http://www.gpnc.org/regal.htm>. Use the information in the article to answer the following questions.**

1. What is the scientific name of the Regal Fritillary? *Speyeria idalia*  
Scientific names have 2 parts. The first word is called the genus and is always capitalized, while the second part is the species, which is always written in lower-case. Sometimes, the subspecies is given as a third part; it is also always lower-case.

2. What plants do Regal Fritillary caterpillars eat? These are called the **host plants**.

*Caterpillars eat only violets. They prefer the Birdsfoot Violet and the Prairie Violet.*

3. When do the adult female butterflies lay their eggs? How do they survive the winter months?

*Eggs are laid in late summer, caterpillars overwinter (or enter diapause, a hibernation stage) and don't start eating until the following spring*

4. Where were Regal Fritillaries originally found? This is called their **range**. Use your pencil to shade in these states on Student Handout 7.2.

*tall grass prairie areas as far east as Maine and as far west as Montana, south to Oklahoma and North Carolina*

5. Where are Regal Fritillaries currently found? Use a different color pencil to shade in these states on Student Handout 7.2.

*Southern Wisconsin west to Montana and south to northeast Oklahoma. They were almost completely eliminated from the Northeast and Mid-Atlantic States.*

6. By what percent did the range (area of the butterfly habitat) get smaller? Use Student Handout 7.2 to estimate your answer.

*By about 50%.*

7. What are possible reasons that the population of Regal Fritillaries declined (went down) over the years?

*Habitat loss - suburban sprawl fragmenting previously continuous prairie areas; conversion to farmland MAY have been a factor but probably not*

*Disease- a virus present among captive butterflies may have spread to wild butterflies*

*Chemicals in the environment- herbicides and pesticides kill butterflies and degrade habitats – use of these chemicals corresponds to period of butterfly's decline*

*Haphazard egg laying behavior - Regals don't search out host plants to lay their eggs on, so when caterpillars hatch they may not find the proper food and will die*

*Additional reasons: global climate change alters the geographic distribution of plant species; introduction of non-native species of plants and animals degrades the butterfly's natural habitat*

8. What are some ways you can think of to conserve (protect) the habitat of the Regal Fritillary?

*Write letters to state representative about need to conserve natural habitat of butterflies, find out about local conservation projects, plant a butterfly garden with host plants like violets that Regal caterpillars like to eat, leave natural butterfly habitats undisturbed*

## Rubric 7.1 for Student Handout 7.1

## Habitats/Conservation

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	2 – Approaching Standards	1 – Below Standards	Score
<b><u>Answers</u></b>	All of the answers are clearly supported with specific examples that are relevant to the question.	Most of the answers are clearly supported with specific examples that are relevant to the question.	At least two of the answers are clearly supported with specific examples that are relevant to the question.	Answers are not clearly supported with specific examples and/or are not relevant to the question.	
<b><u>Accuracy</u></b>	All supportive facts are reported accurately.	Almost all supportive facts are reported accurately.	Most supportive facts are reported accurately.	Most supportive facts are inaccurately reported.	
<b><u>Sentence Structure</u></b>	All sentences are well-constructed with varied structure.	Most sentences are well-constructed and there is some varied sentence structure.	Most sentences are well constructed, but there is no variation in structure.	Most sentences are not well-constructed or varied.	
<b><u>Grammar &amp; Spelling</u></b>	Author makes no errors in grammar or spelling that distract the reader from the content.	Author makes 1-2 errors in grammar or spelling that distract the reader from the content.	Author makes 3-4 errors in grammar or spelling that distract the reader from the content.	Author makes more than 4 errors in grammar or spelling that distract the reader from the content.	

Name: \_\_\_\_\_

Date: \_\_\_\_\_

As you travel through the *Butterflies!* exhibit at the Academy, answer the following questions. What types of butterflies do you see at the museum? List as many as you can:

Do you think that the butterflies' four basic habitat needs are being met? Describe each of them below:

Food- \_\_\_\_\_

Water- \_\_\_\_\_

Space- \_\_\_\_\_

Shelter- \_\_\_\_\_

There are several computers in the conservatory (butterfly garden) with interactive games.

- In the Build a Butterfly Habitat game, what are the three categories that you can change in order to build a butterfly habitat?

\_\_\_\_\_

- Pick a particular host plant and see which butterfly species is most affected by adding that host plant.
- Is it better to use native or non-native plants? Why?
- In the Butterflies and Climate Change game, determine why global warming affects butterflies. What happened to the butterflies between 1900 and 2040?

Why is butterfly farming a good thing?



As you travel through the *Butterflies!* exhibit at the Academy, answer the following questions. What types of butterflies do you see at the museum? List as many as you can:

*Answers will vary.*

Do you think that the butterflies' four basic habitat needs are being met? Describe each of them below:

Food- *students should see caterpillars eating host plants in the tank only (not in the "open" conservatory), and adult butterflies eating from flower nectar or other sources*

Water- *butterflies get water from the nectar or other food that they are eating and may also puddle to get additional nutrients*

Space- *students should see butterflies have sufficient space to fly around, eat, rest*

Shelter- *students should describe the structure of the butterfly enclosure*

There are several computers in the conservatory (butterfly garden) with interactive games.

- In the Build a Butterfly Habitat game, what are the three categories that you can change in order to build a butterfly habitat?

*Host Plants*

*Nectar (and host) Plants*

*Landscaping*

- Pick a particular host plant and see which butterfly species is most affected by adding that host plant.

*These are the butterflies that students can work with at the computer: Eastern Tailed Blue (native), Cabbage White (non-native), Black Swallowtail (native), Monarch (native), Red Admiral (native)*

*These are the host plants that students can work with at the computer:*

*Carrot family (native), Carrot family (non-native), Nettle family (native), Nettle family (non-native), Pea family (native)*

*Also, under "Nectar & Host" category: Milkweed (native) and Black Mustard (non-native)*

*These butterflies use these host plants:*

*Cabbage white=Mustard plants; Black swallowtail=Carrot plants; Red admiral=Nettle plants; Monarch=Milkweed plants; E.Tailed Blue=Pea plants*

- Is it better to use native or non-native plants? Why?

*It's better to use native plants because they attract a greater variety of native butterflies. Non-native species invade the habitat quickly and push out other species.*

- In the Butterflies and Climate Change game, determine why global warming affects butterflies. What happened to the butterflies between 1900 and 2040?

*Even slight temperature changes affect the types of plants that can grow in an area, and butterflies depend on specific plants for their survival. If their plants disappear, the butterflies will also vanish. Between 1900 and 2040, the average global temperatures will likely have increased less than 3.5 °F, but the plants will no longer be able to grow anywhere but at the very highest peak, so most of the butterflies will have died off.*

Why is butterfly farming a good thing? *People that live near the rainforest are able to make money from the forest without cutting it down - this gives them a reason to protect rainforests, which helps butterflies.*

## Rubric 7.3 for Student Handout 7.3

## Habitats/Conservation

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	2 – Approaching Standards	1 – Below Standards	Score
<b><u>Answers</u></b>	All of the answers are clearly supported with specific examples that are relevant to the question.	Most of the answers are clearly supported with specific examples that are relevant to the question.	At least two of the answers are clearly supported with specific examples that are relevant to the question.	Answers are not clearly supported with specific examples and/or are not relevant to the question.	
<b><u>Accuracy</u></b>	All supportive facts are reported accurately.	Almost all supportive facts are reported accurately.	Most supportive facts are reported accurately.	Most supportive facts are inaccurately reported.	
<b><u>Sentence Structure</u></b>	All sentences are well-constructed with varied structure.	Most sentences are well-constructed and there is some varied sentence structure in the essay.	Most sentences are well constructed, but there is no variation in structure.	Most sentences are not well-constructed or varied.	
<b><u>Grammar &amp; Spelling</u></b>	Author makes no errors in grammar or spelling that distract the reader from the content.	Author makes 1-2 errors in grammar or spelling that distract the reader from the content.	Author makes 3-4 errors in grammar or spelling that distract the reader from the content.	Author makes more than 4 errors in grammar or spelling that distract the reader from the content.	

## Rubric 7.R for Reflection Paragraph

## Habitats/Conservation

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	3 – Meets Standards	1 – Below Standards	Score
<b><u>Focus or Thesis Statement</u></b>	The thesis statement names the topic of the paragraph and outlines the main points to be discussed.	The thesis statement names the topic of the paragraph.	The thesis statement outlines some or all of the main points to be discussed but does not name the topic.	The thesis statement does not name the topic AND does not preview what will be discussed.	
<b><u>Accuracy</u></b>	All supportive facts are reported accurately.	Almost all supportive facts are reported accurately.	Most supportive facts are reported accurately.	Most supportive facts are inaccurately reported.	
<b><u>Sentence Structure</u></b>	All sentences are well-constructed with varied structure.	Most sentences are well-constructed and there is some varied sentence structure.	Most sentences are well constructed, but there is no variation in structure.	Most sentences are not well-constructed or varied.	
<b><u>Grammar &amp; Spelling</u></b>	Author makes no errors in grammar or spelling that distract the reader from the content.	Author makes 1-2 errors in grammar or spelling that distract the reader from the content.	Author makes 3-4 errors in grammar or spelling that distract the reader from the content.	Author makes more than 4 errors in grammar or spelling that distract the reader from the content.	

This article was downloaded in its entirety with permission from:

<http://www.gpnc.org/regal.htm>

## Regal Fritillary

**Common Name:**

Regal Fritillary

**Scientific Name:**

*Speyeria idalia*

**Known only from:**

The tall grass prairie of North America

The Regal Fritillary is one of the most striking butterflies to be found on the prairie. As a large "orange and black" butterfly, it may be confused with the Monarch if seen from a distance. However, the hind wings are quite different - dark above and covered with large off-white spots below. Observed closely, the fore wings are distinctive also. The short dark lines running crosswise to the wing veins are not seen on Monarchs.

Males and females may be distinguished as follows:

✦ Upper Forewings - Females have a dark patch at the wing tip and a row of small white spots along the outer margin.

✦ Upper Hindwings - The spots are all pale yellow on females. On males, the inner row is white and the outer row is orange.

The caterpillars of Regals, as is true of most fritillaries, eat only violets. In particular, Regals prefer the Birdsfoot Violet [*Viola pedata*] and Prairie Violet [*Viola pedatifida*]. The eggs are laid in late summer. The newly hatched caterpillars overwinter and begin eating the following spring. They are black and yellow with short branching spiny hairs. The adults emerge in early summer and may be seen through September. Only one generation appears in a year.

The known range of the Regal Fritillary originally stretched from Maine to Montana and south to Oklahoma and North Carolina. Because the caterpillars utilize the prairie species of violets, this species was never found outside tall grass prairie.

Regals have almost disappeared from their former range east of the Mississippi River. They now occur only from southern Wisconsin west to Montana and south to northeast Oklahoma. Some relict populations occur in Pennsylvania and Maryland, but they may not last much longer. It is a species of concern for the United States Fish and Wildlife Service.

Why has the Regal Fritillary gone into such a sharp decline?

- ✦ Habitat loss is a definite possibility. The greatest decline in Regal populations was noticed over the last 40 years, so conversion of prairie to farmland is probably not to blame because most of that occurred before that period. Suburban sprawl has definitely had an impact on relict prairies during that time, however, and maybe that is a factor.
- ✦ Another possibility is disease. Captive populations being kept for reintroduction purposes have been hit by a virus that is transmitted from parents to young. If this is active in the wild populations, that would be a serious matter.
- ✦ Could chemicals in the environment be to blame? The disappearance of the Regals coincides with the onset of widespread use of herbicides and pesticides in agriculture. No such relationship has been established, but the overlap of the two trends is suggestive and should be investigated.
- ✦ One thing that does not help is the haphazard egg laying behavior of Regals. Most butterfly mothers will lay their eggs directly on the host plant that the caterpillar will consume. Regals, however, just wander around laying their eggs throughout their grassland habitat rather than directly on or next to the violets that the caterpillars will need. Then, the caterpillar will hatch before winter, but not begin feeding until the following spring! This extremely risky strategy may explain why a Regal female may lay up to 2,400 eggs - which is far more than most butterfly females will lay.

If you have Regals to watch, their behavior is quite interesting. The males will be zipping about looking for females, who will probably be either feeding, calmly perched somewhere down in the vegetation or, if they have mated already, moseying around laying eggs. If a male spots a female he attempts to win her favor. If he is an unwanted suitor, the female will fly rapidly upwards perhaps 100 feet in the air and then suddenly dive to the ground to shake him off. If she finds him to her liking, she will lead him in a short flight over the prairie to a suitable perch for mating. This is similar to the mating behavior of a lot of butterflies.

If you find the Regals feeding at flowers, they will be much more viewable. A slow, careful approach without sudden movements will get you almost nose-to-antenna with them or most any other butterfly. Using a good pair of close-focusing binoculars will allow you the same view but from a more comfortable distance for both you and the butterfly. Watch as they probe each flower for nectar with their proboscis. Look for interaction between them and other insects that come to the flowers. Butterflies can be quite pugnacious sometimes, and quite tolerant of other insects at other times.

Regal Fritillaries can be seen all summer long in the right habitat. If you see them, you know that you are in a high-quality tall grass prairie - a remnant of what used to be the most extensive habitat type in North America, but which is now much reduced in area. Finding both together is a rare, precious and beautiful experience.

**Target:** 5-8<sup>th</sup> Grade

**Duration:** One 45-minute lesson w/extension options and parent links

**Discipline Connections:** Science, Math, English, Visual Arts, Technology, Civics

**Before Lesson/Materials:** Copies of Student Handouts 8.1 and 8.2 and Rubrics 8.1.A, 8.1.B, and 8.R for each student

**Word Bank:** Threatened Species, Endangered Species, Extinct Species, Advocacy, Conservation, Habitat, Climate

**Objective:** Students will demonstrate their ability to create persuasive print materials to promote awareness regarding butterfly conservation.

**Background:** In this lesson, students will create public awareness materials to promote the conservation of butterflies and their habitats. *(This activity may take longer than one 45-minute lesson, but suggestions are given in the procedures to accommodate for the extra time.)*

**Focusing Question:** Make a list of 5 foods and drinks that you could not live without. Now imagine that all 5 of the things on your list did not exist. Write to explain what would happen to you and how you would feel. What would you do to prevent this from happening?

**Procedure:**

1. Have students respond in writing to the focusing question. Select a few students to share highlights from their responses.
2. Explain that students will learn about the dangers facing butterflies and their habitats, and what they can do to help the butterflies.
3. State the lesson's objective and write the objective on the board.
4. Introduce the new vocabulary.
5. Read Aloud from Teacher Handout 8.1 (*you may decide to distribute this handout*) and Teacher Handout 8.2 (*if you wish*).
6. With the whole class, brainstorm a list of reasons that butterflies and their habitats are endangered.
7. Record student responses on the board or use chart paper and display in the classroom. *(In order to build background knowledge, you may want to allow time for students to conduct research on endangered butterflies and habitats prior to this lesson.)*
8. Divide your students into groups of 4-6 students.
9. Distribute Student Handouts 8.1 and 8.2 and Rubrics 8.1.A and 8.1.B.
10. Allow time for students to select their roles and project topics.
11. Read all of the directions aloud and allow time for students to ask questions.
12. Students may need time to complete their projects outside of the normal 45-minute class period. Provide enough in-class support so that students can complete components of their projects outside of class.

**Reflection:** Have students write a letter from the perspective of a butterfly or habitat informing readers how community members can help protect its life. Distribute Rubric 8.R.

**Assessment:** Completed advocacy projects, butterfly letters

### **Extension Options:**

- Read the book entitled, 50 Simple Things Kids Can Do to Save the Earth (Paperback) by The EarthWorks Group (published by Andrews McMeel, ISBN# 0836223012).
- Have students choose 5 earth saving ideas and write an explanation of how their actions would help to save butterflies.
- Have students conduct research and create a list of organizations that support butterfly conservation. Have students then choose their favorite organization and organize a fundraising campaign in order to donate money.
- Have students create invitations for the school's student body inviting them to their public awareness events.
- Have students create a butterfly newsletter with a conservation theme and have them distribute the newsletter throughout the school.

### **Parent-Links:**

- Join the Young Entomologists' Society, located at:  
6907 West Grand River Ave.  
Lansing MI 48906-9158  
Phone/fax: 517-886-0630  
E-mail: [YESbugs@aol.com](mailto:YESbugs@aol.com)  
On the web at: <http://members.aol.com/yesbugs/mainmenu.html>
- Design flyers to raise community awareness about the conservation of butterflies and habitats. Post them around the neighborhood.

### **Resources:**

- <http://www.timeforkids.com/TFK/>
- <http://www.kidsnewsroom.org/>
- [http://www.pbs.org/newshour/bb/congress/july-dec97/cartoons\\_7-28.html](http://www.pbs.org/newshour/bb/congress/july-dec97/cartoons_7-28.html)
- <http://www.newsweekeducation.com/extras/policartoons1.php>
- <http://www.kidsfreesouls.com/pressrelease.htm>
- <http://www.publicityinsider.com/release.asp>
- <http://www.microsoft.com/downloads/details.aspx?FamilyId=4D64D8E1-180F-4A79-9936-1EFB540B1C15&displaylang=en>
- <http://www.gc.maricopa.edu/studentlife/ClubGuide/eventindex.htm>

### **Standards:**

***Philadelphia City Standards:*** Reading 1, 2, 3; Writing 1, 2, 3; Speaking 1, Listening 1, Social Studies 2, 3, 4, 6; Science 1, 2, 3, 5, 6, 7; Math 6; Art 1, 7

***Pennsylvania State Standards:*** Reading, Writing, Speaking, Listening 1.1, 1.2, 1.4, 1.5, 1.6, 1.8; Geography 7.3D and E, 7.4 A and B; Science and Technology 3.1A and E, 3.5B, 3.6B, 3.7C and E, 3.8 C; Family and Consumer Sciences 11.2C and H; Math 2.4; Art 9.1B, I, J, and K; Environment and Ecology 4.5A, 4.7B, 4.8C, 4.9A; Civics and Government 5.1A, C, J, and M, 5.2A, D, E, F and G, 5.3J

*\*\*Teacher Note\*\* The READ ALOUD below is an edited compilation of a few of the articles found on: <http://butterflywebsite.com/articles/constructlist.cfm?type=conservation>. For additional resources, follow this link to download articles about conservation efforts from around the world. An additional article is included on Teacher Handout 8.2, which you can read at your discretion.*

## **READ ALOUD**    Butterfly and Habitat Conservation

### Primary Reasons for Loss of Butterflies and Caterpillars

1. Destruction of habitat, due to such reasons as deforestation, pollution, industrialization, farming, and climate change, has the greatest impact on the loss of butterflies and caterpillars. Be sure to listen carefully for the causes of habitat change. You'll be surprised by how many factors directly affect the habitat of butterflies and caterpillars.

### Migrating Monarchs

1. Spring and summer Monarch habitat in North America is being lost to road building and housing developments. Also, many people kill or remove milkweed because they think of it as weed, but Monarchs need milkweed to survive (it's all they eat as caterpillars).
2. Millions of Monarch butterflies spend the winter in just a dozen or so sites in Mexico. Dr. Karen Oberhauser of the University of Minnesota at Minneapolis used a computer model to predict the future of January weather in these habitats. The analysis predicted that, while temperatures would stay Monarch-friendly in these sites, precipitation would more than triple by 2050. Monarchs have never been known to survive in such wet conditions.
3. Some of the Mexican wintering sites are being logged for timber. This opens patches of the forest up to rain and snow, causing some Monarchs to freeze.
4. Forest sites in California where other Monarchs spend the winter are being cut down for wood and to develop land. The butterflies do not have anywhere else to go.

### General Threats to Butterflies

1. Millions of butterflies die every week on roads in Florida, but getting hit by cars and trucks is only part of the danger they face. Spraying for mosquito control and mowing of roadside plants also wreak havoc on Florida's butterfly populations.
2. Electronic bug zappers can decrease the growth of nectar flowers on which butterflies feed. Electric bug zappers may kill up to 350 billion beneficial bugs every year (including insects that pollinate flowers). Less than 1 percent of the bugs being killed are actually biting flies or gnats, according to a University of Delaware study.
3. In various parts of the United States, chemical pesticides are sprayed to fight outbreaks of gypsy moths, which are pests. However, many harmless species of moths and butterflies are also exposed to the spraying. The pesticides kill them.
4. Global warming is killing off Edith's Checkerspot butterflies in southern parts of its range in Mexico and California and forcing them to move further north in Canada. Butterflies living at lower altitudes have also had to move to higher elevations to find cooler temperatures and the plants they need to survive.
5. Many populations of butterflies in Britain have disappeared. Their natural habitats have been lost to expanding cities and suburbs and to modern farming practices.
6. Natural rainforest in parts of Central America is being logged for timber. Trees are also cut down to create gold mines. These mining operations pollute the forest.
7. The Sacramento Mountains Checkerspot butterfly only lives in high mountain meadows in and around the village of Cloudcroft, New Mexico. These meadows are being harmed by off-road vehicle use, livestock grazing, and pesticide spraying.



*The following article produced by the North American Butterfly Association was downloaded in its entirety from: <http://www.naba.org/weddings.html>*

## There's No Need to Release Butterflies -- They're Already Free

*by Jeffrey Glassberg (president of the North American Butterfly Association); Paul Opler (author of the [Peterson Field Guide to Eastern Butterflies](#)); Robert M. Pyle (author of the [National Audubon Society Field Guide to Butterflies](#)); Robert Robbins (Curator of Lepidoptera at the Smithsonian Institution) and James Tuttle (president of The Lepidopterists' Society)*

Most fifth graders can tell you how the magnificent Monarch butterflies migrate thousands of miles every autumn from the United States and Canada to a few small mountain tops in Mexico. There they find the right environmental conditions that allow them to survive the winter. With the advent of spring, they begin their return journey. This migratory phenomenon is truly a wonder of nature that sparks the imagination.

Now imagine tens of thousands of mixed-up Monarchs unable to find the way to their overwintering grounds. This depressing image may become a reality if the rapidly-growing fad of releasing butterflies, including Monarch butterflies, at weddings, state fairs, and other public events continues to spread. Because the released Monarchs may have come from California, for instance, where they do not migrate to Mexico, their offspring may not be able to orient properly. Because the Monarchs were raised inside under unnatural conditions, it is possible that their delicate migratory physiology may not have been turned on.

Public interest in butterflies is increasing dramatically. We hope and expect this greater involvement with butterflies will eventually lead to much-needed support for butterfly conservation and studies, but the release of live butterflies is the dark side of this increase in popularity. Although this practice is understandable to naive newlyweds-to-be (what could be more beautiful than adding butterflies to the environment?) it is really a particularly long-lasting form of environmental pollution.

Butterflies raised by unregulated commercial interests may spread diseases and parasites to wild populations, with devastating results. Often, butterflies are released great distances from their points of origin, resulting in inappropriate genetic mixing of different populations when the same species is locally present. When it is not, a non-native species is being introduced in the area of release. At best, this confuses studies of butterfly distribution and migration; at worst, it may result in deleterious changes to the local ecology. The Hollywood Jurassic park message, "Don't fool with Mother Nature," has scientific foundations. Recently a high profile report in Science magazine found that even the careful introduction of species for biological control often causes unexpected negative results.

In addition, these releases create a commercial market for live butterflies (currently about \$10/apiece), with the result that, for example, the Monarch overwintering sites in Mexico and on the California coast are now targets for poachers.

Currently, the interstate shipment of live butterflies requires a permit from the U.S. Department of Agriculture but this law is not usually enforced. In general, the Dept. of Agriculture may issue a permit for shipping any of the following species: Monarch, Painted Lady, American Lady, Red Admiral, Giant Swallowtail, Gulf Fritillary, Zebra (Heliconian), and Mourning Cloak. Shipping Red Admirals, Giant Swallowtails, Gulf Fritillaries and Zebra (Heliconians) is particularly inappropriate because they are not naturally found over much of the United States.

A solution that better serves the public interest with less regulatory burden is to ban the environmental release of commercially-obtained butterflies (we would exempt education institutions, although even here we would encourage schools to keep commercially-obtained butterflies within the confines of the school). The intentional release of native birds was outlawed in 1947. The time has come to do the same with butterflies. \*\*

In addition to the above, many wedding planners now avoid butterflies at weddings because they not infrequently arrive dead, or half-dead. (See the recent article in the New York Times "Festive Release of Butterflies Puts Trouble in the Air" on page F4 of the Sept. 15, 1998 edition). Even if alive, they often will soon die because they are released at the wrong time of year, or at the wrong locality to survive.

A truly beautiful and environmentally friendly way to celebrate a wedding is to throw rose petals. You can even use outdated roses from your florist.

----- End of Article -----

\*\* NOTE: You can protect wild butterfly populations by “freeing” your class-raised butterflies at The Academy of Natural Sciences instead. At the Academy, the butterflies can be released directly into the *Butterflies!* conservatory (the indoor butterfly garden), where they will live out the remainder of their lives protected from predators and bad weather. For more information on this release program, please call Mike Sikorski, the butterfly keeper, at 215-299-3796.

**Advocacy Activity Ideas**

**Directions:** In your group, decide which activity you would like to complete. Follow the directions for the option you choose. Be sure to read the Rubric that matches your selection thoroughly so that you understand what is expected of your group.

**Activity A** Write a newspaper editorial with a political cartoon. First, decide to which paper you will submit your editorial (a student newspaper, online publication, local paper, national circulation paper, blog, etc.). Then, define your intended audience based on the newspaper publication that you selected. Read several editorials and view several political cartoons in newspapers to generate ideas and become familiar with the format. Check out the following websites for support on writing editorials:

- <http://www.timeforkids.com/TFK/>
- <http://www.kidsnewsroom.org/>

Check out the following websites for support on designing political cartoons:

- [http://www.pbs.org/newshour/bb/congress/july-dec97/cartoons\\_7-28.html](http://www.pbs.org/newshour/bb/congress/july-dec97/cartoons_7-28.html)
- <http://www.newsweekeducation.com/extras/polcartoons1.php>

Your article must include:

- the issue
- your opinion
- supportive details that defend your opinion
- a request for action from the reader
- a political cartoon that illustrates your opinion
- a one-page bibliography

**Activity B** Create a public awareness campaign. First, decide what audience you are trying to reach and what message you want to convey. You must create a press kit that advertises a self-designed event that will promote the conservation of butterflies and their habitats. Your press kit must include:

- a press release
- a description of the event (fundraiser, telethon, community fair, etc.)
- at least two promotional materials for the event (poster, flyer, design for a front page of a website, or other acceptable document)
- an email that can be sent to a mass group of people
- a one-page bibliography

Check out the following websites for support on creating a press release, flyer, or web design:

- <http://www.kidsfreesouls.com/pressrelease.htm>
- <http://www.publicityinsider.com/release.asp>

The following websites can help with event planning:

- Download a template for your event:  
<http://www.microsoft.com/downloads/details.aspx?FamilyId=4D64D8E1-180F-4A79-9936-1EFB540B1C15&displaylang=en>
- Read through event planning checklists and brainstorming ideas:  
<http://www.gc.maricopa.edu/studentlife/ClubGuide/eventindex.htm>

**Advocacy Project**

- 1.) Your group will only have \_\_\_\_ minutes to complete your advocacy project.
- 2.) In your group, read your handout and choose your project.
- 3.) Assign roles to each group member.
- 4.) Please read the roles below and sign your name on the role that you will fulfill.

**Roles and Responsibilities**

***Reader*** Responsibilities:

- You will read the handout aloud to your group.
- You will ensure that all group members can hear you.
- You will reread the handout as necessary.
- You will read aloud the research that applies to your project.

\_\_\_\_\_  
Student Name

***Researcher*** Responsibilities:

- You will alert your group to specific ideas and details that are important.
- You will ensure that your ideas are recorded properly.
- You will control the mouse and keyboard during Internet research.

\_\_\_\_\_  
Student Name

\_\_\_\_\_  
Student Name

***Recorder*** Responsibilities:

- You will record your group's ideas.
- You will takes notes on scrap paper and confirm the accuracy of your notes with your group.
- You will choose some of your partners to help you make good copies of all of your work.

\_\_\_\_\_  
Student Name

\_\_\_\_\_  
Student Name

***Taskmaster*** Responsibilities:

- You will keep your group focused and maintain a clear idea of the time limits.

\_\_\_\_\_  
Student Name

## Rubric 8.1.A for Student Handout 8.1/Editorial and Cartoon      Habitats/Conservation

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	2 – Approaching Standards	1 – Below Standards	Score
<b><u>Who, What, When, Where &amp; How</u></b>	All articles adequately address the who, what, when, where, and how.	90-99% of the articles adequately address the who, what, when, where, and how.	75-89% of the articles adequately address the who, what, when, where, and how.	Less than 75% of the articles adequately address the who, what, when, where, and how.	
<b><u>Supporting Details</u></b>	The details in the articles are clear, effective, and vivid 80-100% of the time.	The details in the articles are clear and pertinent 90-100% of the time.	The details in the articles are clear and pertinent 75-89% of the time.	The details in more than 25% of the articles are neither clear nor pertinent.	
<b><u>Usefulness</u></b>	The information was accurate and there was a clear reason for including the editorial in the newspaper.	The information was accurate and there was a fairly good reason for including the editorial in the newspaper.	The information was occasionally inaccurate or misleading, but there was a clear reason for including the editorial in the newspaper.	The information was typically inaccurate, misleading or libelous.	
<b><u>Resources</u></b>	Reading of resource material was thorough.	Reading of resource material was fairly thorough.	Reading of resource material was incomplete.	Reading of resource material was not done.	
<b><u>Articles - Purpose</u></b>	90-100% of the articles establish a clear purpose in the lead paragraph and demonstrate a clear understanding of the topic.	85-89% of the articles establish a clear purpose in the lead paragraph and demonstrate a clear understanding of the topic.	75-84% of the articles establish a clear purpose in the lead paragraph and demonstrate a clear understanding of the topic.	Less than 75% of the articles establish a clear purpose in the lead paragraph and demonstrate a clear understanding of the topic.	

## Rubric 8.1.B for Student Handout 8.1/Awareness Campaign      Habitats/Conservation

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	2 – Approaching Standards	1 – Below Standards	Score
<b><u>Brainstorming - Problems</u></b>	Students identify more than 3 reasonable, insightful barriers/problems that need to change.	Students identify at least 3 reasonable, insightful barriers/problems that need to change.	Students identify at least 2 reasonable, insightful barriers/problems that need to change.	Students identify fewer than 2 reasonable, insightful barriers/problems that need to change.	
<b><u>Brainstorming - Solutions</u></b>	Students identify more than 3 reasonable, insightful possible solutions/strategies to encourage change.	Students identify at least 3 reasonable, insightful possible solutions/strategies to encourage change.	Students identify at least 2 reasonable, insightful possible solutions/strategies to encourage change.	Students identify fewer than 2 reasonable, insightful possible solutions/strategies to encourage change.	
<b><u>Research/ Statistical Data</u></b>	Students include 3 or more high-quality examples or pieces of data to support their campaign.	Students include at least 2 high-quality examples or pieces of data to support their campaign.	Students include at least 1 high-quality example or piece of data to support their campaign.	Students include no high-quality examples or pieces of data to support their campaign.	
<b><u>Resources</u></b>	Students include 3 or more high quality sources.	Students include 2-3 high quality sources.	Students include 2-3 sources but some are of questionable quality.	Students include fewer than 2 sources.	
<b><u>Sources - Citations</u></b>	Information in all source citations is correct and in the format assigned.	Information in all source citations is correct but there are minor errors in formatting.	Information in almost all source citations is correct AND there are minor errors in formatting.	The information is often incorrect OR there are major errors in formatting.	

# Rubric 8.R for Reflection Letter

# Habitats/Conservation

Student Name: \_\_\_\_\_

CATEGORY	4	3	2	1	Score
<b><u>Salutation and Closing</u></b>	Salutation and closing have no errors in capitalization or punctuation.	Salutation and closing have 1-2 errors in capitalization or punctuation.	Salutation and closing have 3 or more errors in capitalization or punctuation.	Salutation and/or closing are missing.	
<b><u>Ideas</u></b>	Ideas were expressed in a clear and organized fashion. It was easy to figure out what the letter was about.	Ideas were expressed in a pretty clear manner, but the organization could have been better.	Ideas were somewhat organized, but were not very clear. It took more than one reading to figure out what the letter was about.	The letter seemed to be a collection of unrelated sentences. It was very difficult to figure out what the letter was about.	
<b><u>Content – Accuracy</u></b>	The letter contains at least 5 accurate facts about the topic.	The letter contains 3-4 accurate facts about the topic.	The letter contains 1-2 accurate facts about the topic.	The letter contains no accurate facts about the topic.	
<b><u>Grammar &amp; Spelling (Conventions)</u></b>	Writer makes no errors in grammar or spelling.	Writer makes 1-2 errors in grammar and/or spelling.	Writer makes 3-4 errors in grammar and/or spelling.	Writer makes more than 4 errors in grammar and/or spelling.	

**Target:** 5<sup>th</sup>-8<sup>th</sup> Grade

**Duration:** One 45-minute lesson w/ extension options and parent links

**Discipline Connections:** Science, English, Visual Arts, Technology, Geography

**Before the Lesson/ Materials:** Copies of Student Handout 9.1, Student Handout 9.4(optional), and Rubrics 9.1, 9.4 (optional), and 9.R for each student; copies of Student Handouts 9.2 and 9.3 for each group; markers, colored pencils, crayons, construction paper, tape, glue

**Word Bank:** Sense, Adaptation, Migration, Predator, Ocelli, Compound Eyes, Tactile, Setae, Antennae, Sense Receptor (Chemoreceptor, Photoreceptor), Proboscis, Pheromone, Tarsus, Ovipositor, Exoskeleton

**Objective:** Students will demonstrate their understanding of adaptations and how different senses help butterflies survive and reproduce in their environment.

**Background:** Butterflies have many sensory adaptations to help them navigate through their world. They use their senses to find food and mates, lay eggs in an appropriate place, migrate, and avoid hungry predators. The way butterflies sense the world changes as they move through different stages of their life.

**Focusing Question:** Listed below are the five senses that people use to understand their world. Describe 1) what part of your body is used for that sense, 2) how that sense works in your body, and 3) why that sense is an important adaptation.

**Procedure:**

1. Distribute Student Handout 9.1. Have students respond in writing to the focusing question and select a few students to share highlights from their responses.
2. State the lesson's objective and write the objective on the board.
3. Introduce the activity "Design an Owner's Manual for a Butterfly Sense" on back of Student Handout 9.1. Pass out Rubric 9.1.
4. Divide class into groups of 4. Distribute Student Handout 9.2 to each group and assign one sense to each. (*Based on your own assessment of Handout 9.3, you can choose whether to assign senses based on the traditional five categories, to group the senses together as on the handout, or to assign your own categories – for instance, "Light Detection" as a separate sense from "Vision".*)
5. Distribute Student Handout 9.3 to each group. An optional, additional resource for this activity is the following website from which you may print out handouts for sight, taste and smell, touch, and hearing: <http://www.Monarchwatch.org/biology/sense1.htm>.
6. Have students present their owner's manuals to the class.
7. Students may need additional class time to finish their manuals.

**Museum Activities (optional):**

8. At the Academy's *Butterflies!* exhibit, students will observe the senses used by a butterfly.
9. Distribute Student Handout 9.4 and Rubric 9.4.



**Reflection:** Have students review what they learned about butterfly senses. Which sense or senses do they think are the most important for the butterfly? Why? They should provide specific examples to support their answers. Distribute Rubric 9.R.

**Assessment:**

Completed Owner's Manual, Student Handout 9.4, Reflection Paragraph

**Extension Options:**

- Have students read the book The Five Senses, by Keith Faulkner, illustrated by Jonathan Lambert (published by Cartwheel, ISBN#0439388821), to a lower level class and have students bring their owner's manuals with them to describe how butterflies use their senses to navigate the world.
- Have students read the article "Beauty with Brains", available at: <http://www.nwf.org/nationalwildlife/article.cfm?issueID=67&articleID=905>
- Have students complete research on other amazing animal senses. They can select one of the organisms included at the following website: <http://faculty.washington.edu/chudler/amaze.html>  
Another website with useful information about animal super-senses is: <http://www.nationalgeographic.com/ngkids/0006/senses/index.html>
- Have students write a one-page story about how their lives would be different if one of their senses were taken away. Have them consider how their other senses might be heightened.
- Have students participate in a PBS interactive activity, where students take on the role of a salmon. Their goal is to move from the open ocean to a specific location in a stream far inland, using only their sense of smell. Resource: <http://www.pbs.org/wgbh/nova/hokkaido/migration.html>
- Have students participate in a Journey North lesson, where students will explore the concept of time and their own ability to keep time. Then they will consider the importance of biological clocks to migratory species. Resource: <http://www.learner.org/jnorth/tm/BioClock.html>

**Parent-Links:**

- Have students participate in activities to test their own five senses. Activities may be found at the following website: <http://faculty.washington.edu/chudler/chsense.html>

**Resources:**

- <http://www.Monarchwatch.org/biology/sense1.htm>
- <http://www.nwf.org/nationalwildlife/article.cfm?issueID=67&articleID=905>
- <http://faculty.washington.edu/chudler/amaze.html>
- <http://faculty.washington.edu/chudler/chsense.html>
- <http://www.nationalgeographic.com/ngkids/0006/senses/index.html>
- <http://www.pbs.org/wgbh/nova/hokkaido/migration.html>
- <http://www.learner.org/jnorth/tm/BioClock.html>

**Standards:**

***Philadelphia City Standards:*** Reading 1,2,3; Writing 1,2,3; Speaking 1; Listening 1; Science 1,4,5,6; Arts 1,7

***Pennsylvania State Standards:*** Reading, Writing, Speaking, Listening 1.1,1.2,1.4,1.5,1.6,1.8; Geography 7.4A-B; Science and Technology 3.1A and E, 3.3A-B, 3.6B, 3.7 C,E; Family and Consumer Sciences 11.2H; Math 2.4, 2.5; Art 9.1 B, I, J, and K, Environment and Ecology 4.5A, 4.7B

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Focusing Question:

Listed below are the five senses that people use to understand their world. Describe 1) what part of your body is used for that sense, 2) how that sense works in your body, and 3) why that sense is an important **adaptation**.

*An **adaptation** is a physical or behavioral characteristic that helps an organism survive and reproduce in its environment.*

Sight

Smell

Taste

Hearing

Touch

Which of your senses is most important to you? Why? Describe and give some examples.

## **Design an Owner's Manual for a Butterfly Sense!**

Pretend you are an adult butterfly and your job is to design an owner's manual for one of your senses. You will be passing on your owner's manual to the next generation of butterflies, so you have to make sure to explain in detail how that sense works during your life, specifically in the caterpillar and the adult stages. Use your creativity to make a brochure in any format you would like. You must answer the following questions:

- Why is this sense an important adaptation? When do you use this sense? Where do you use this sense?
- What would happen if this sense did not exist?
- Which part of your body controls this sense in a caterpillar and in an adult? How do you use that part of your body?
- What is the most exciting thing you can do with this sense?
- What is the most exciting thing you have ever sensed with this sense?

Your brochure must include the following:

- A title
- Names of group members
- At least one picture of the sense organ

**Directions:**

1. Your group will only have \_\_\_\_ minutes to complete your owner’s manual.
2. Your group is working on the following sense: \_\_\_\_\_
3. In your group, read the handouts given to you by your teacher and discuss the most important facts about that sense.
4. Your group will record the most important facts and answer the necessary questions on scrap paper.
5. Next, your group will design an owner’s manual for that sense. Discuss with your group how you would like to design the manual. Gather any materials you will need.
6. Please read the roles below and sign your name on the role that you will fulfill.

**Roles and Responsibilities:**

*Reader Responsibilities:*

- You will read the handouts aloud to your group.
- You will ensure that all group members can hear you.
- You will reread the handout as necessary.

\_\_\_\_\_  
Student Name

*Observer and Presenter Responsibilities:*

- You will alert your group to specific ideas and details that are important.
- You will ensure that your ideas are recorded properly.
- You will present the owner’s manual from your group to the class.

\_\_\_\_\_  
Student Name

*Recorder Responsibilities:*

- You will record your group’s ideas.
- You will takes notes and answer the questions on scrap paper and confirm the accuracy of your notes with your group.
- You will transfer your notes to the final owner’s manual.

\_\_\_\_\_  
Student Name

\_\_\_\_\_  
Student Name

## Rubric 9.1 for Student Handout 9.1

## Adaptations/Senses

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	2 – Approaching Standards	1 – Below Standards	Score
<b><u>Required Questions</u></b>	The flyer includes all required questions as well as additional information.	All required questions are included on the flyer.	All but 1 of the required questions is included on the flyer.	Several required questions were missing.	
<b><u>Content - Accuracy</u></b>	At least 5 accurate facts are displayed on the flyer.	4 accurate facts are displayed on the flyer.	2 accurate facts are displayed on the flyer.	Less than 2 accurate facts are displayed on the flyer.	
<b><u>Pictures</u></b>	Several of the pictures used on the poster reflect an exceptional degree of student creativity in their creation and/or display.	One or two of the pictures used on the poster reflect student creativity in their creation and/or display.	The pictures are made by the student, but are based on the designs or ideas of others.	No pictures made by the student are included.	
<b><u>Attractiveness</u></b>	The flyer is exceptionally attractive in terms of design, layout, and neatness.	The flyer is attractive in terms of design, layout and neatness.	The flyer is acceptably attractive though it may be a bit messy.	The flyer is distractingly messy or very poorly designed. It is not attractive.	
<b><u>Use of Class Time</u></b>	Used time well during each class period. Focused on getting the project done. Never distracted others.	Used time well during each class period. Usually focused on getting the project done and never distracted others.	Used some of the time well during each class period. There was some focus on getting the project done but occasionally distracted others.	Did not use class time to focus on the project OR often distracted others.	

# Butterfly Senses

Butterflies perceive the world quite differently than humans do. Although we have some senses in common, they may not be used in exactly the same way. For instance, butterflies smell even though they don't have noses, and they can see things that people can't! It may be hard for us to understand all the things that butterflies sense, since we can only know what our own five senses tell us. Butterflies use their senses to find food, to identify and communicate with mates, to locate the right plants on which to lay their eggs, to avoid predators and other dangers, and to move from place to place.

## Sight

Caterpillars do not have very good vision. They have “simple eyes”, also called ocelli. These are made up of photoreceptors, nerve cells that are sensitive to light. Ocelli do not see images, but they can sense light and shadow. This is important because light levels shift as storms approach, seasons and the length of daylight change, or large predators get close. Caterpillars typically have twelve ocelli, six on each side of the head, but different species may have fewer.

Adult butterflies have two “compound eyes”. These large, rounded eyes are made up of thousands of tiny, hexagon-shaped units. They are able to see in almost all directions at once, because each individual unit has a lens that senses its own visual information. We cannot know exactly what an image looks like to butterflies after their brains combine and interpret all this information. Butterflies are probably pretty near-sighted (that is, they only see well when they are close to something). We know that compound eyes are excellent at detecting movement and color, which is important for sensing predators, finding and communicating with mates, and locating food plants.

Butterflies see many of the same colors that people do, such as yellows, reds, oranges, pinks, and purples. However, they also perceive ultraviolet (UV) light, which is invisible to people. Colors or patterns that can be seen only under UV light may guide butterflies to the nectar in a flower or help them recognize an appropriate mate. Butterflies detect polarized light, too (that is, they can tell in which direction light is moving). In addition to compound eyes, adult butterflies also have a few ocelli. These simple eyes sense the sun's position. This helps migrating butterflies determine in which direction they are flying.

## Smell and Taste

Caterpillars and butterflies smell and taste with chemoreceptors that are located on various parts of their bodies. These are special nerve cells sensitive to different chemicals. Humans have similar receptors in our noses and on our tongues (our “taste buds”). “Tastes” are chemicals encountered on contact with a liquid or solid. “Smells” are scents - chemicals in the air. Caterpillars use taste and smell to make sure they are eating the right foods. They have taste receptors on parts of their mouths called palps and maxillae. Tiny antennae near their mouths may detect smells or tastes as well.

Adult butterflies primarily smell with their antennae, although a few other body parts can detect specific odors as well. Receptors all over the antennae and especially on its tip are extremely sensitive to pheromones and plant scents. Pheromones are airborne chemicals produced by one gender to attract members of the opposite sex (depending on species, either sex may produce pheromones). Butterflies locate both nectar and larval food plants by tracking scents, which they can detect from quite a distance. Taste is then used to confirm whether a plant is appropriate food.

Butterflies taste with their feet and legs. When a female butterfly lands on a leaf to lay eggs, she beats her feet, or tarsi, against the plant to release some of its juices. Chemoreceptors along her legs taste the juices to make sure she has landed on the right host plant for her young to eat. If the taste is wrong, she will not lay her eggs on that plant. Some females even have taste sensors on the ovipositor (the structure with which they lay eggs) to confirm they are on the correct host plant. Both males and females also have receptors in their tarsi that respond to contact with sugar. The proboscis (the tube-like mouth part) uncoils automatically when a butterfly's feet touch a nectar plant. Various parts of the mouth, including the proboscis and palps, taste sugar as well.

### **Hearing and Touch**

Caterpillars and the majority of butterflies do not have anything resembling an ear. They do not “hear” in the way people do. Instead, they “feel” sound, by sensing vibrations. Their bodies are covered with tactile setae, which grow through the exoskeleton. These are special hairs or bristles attached to nerve cells that are sensitive to touch.

Many caterpillars look fuzzy because they have setae scattered across their bodies and faces. These sensory hairs enable them to feel their environment and also sense sudden air movements resulting from sharp noises. Many caterpillars will react to something touching them directly by curling up or falling away. Some species respond in a similar way to loud sounds, by rearing up or dropping from their branches. They do not react to softer sounds or ongoing noises. This suggests the behaviors developed as a defense against a suddenly-appearing predator.

Adult butterflies also have setae everywhere. They sense touch as well as vibrations along their wings, bodies, and faces. A few species have a kind of “simple ear”, similar to an eardrum, that hears certain sound frequencies. It is a thin membrane stretched over a small hole containing sensory nerves that can be located near the base of the wings. However, most butterflies are essentially deaf, detecting vibrations from only very loud sounds.

Adult butterflies can use their antennae to touch objects or other butterflies. This is done more in some species than others. They also use their antennae to maintain balance while flying. They do this by “feeling” the air, sensing things like wind movement and gravity. Setae also help a butterfly to balance itself by letting it feel the positions of its different body parts.

Name: \_\_\_\_\_

Date: \_\_\_\_\_

### **Sight**

How do butterflies see? How is their vision similar to and different from ours?

Why is it important for butterflies to see ultraviolet light?

How do simple eyes help butterflies migrate?

### **Taste**

Butterflies can taste with their feet. Why is this an important adaptation?

What is the proboscis of a butterfly? Do you see any butterflies using their proboscises?

Do you see any caterpillars eating? If so, describe what you see.

### **Smell**

What do you smell in the conservatory (butterfly garden)? Describe how butterflies would smell these scents.

### **Hearing**

Do you think that butterflies can hear you? What evidence do you see that they can or cannot hear?

### **Touch**

What do you see butterflies touching in the conservatory?

After your visit to the Academy, think about the many ways in which butterflies use their senses. List as many ways as possible:



**Sight**

How do butterflies see? How is their vision similar to and different from ours?

*Butterflies see with compound eyes, made of many image-sensing lenses. They easily spot motion and can see in many directions without turning their heads. They are likely very nearsighted. They see colors like red, yellow, orange, pink, and purple, lavender, as well sensing UV light and polarized light (neither of which we cannot see). They also have simple eyes (each with a single lens) that don't see forms, just light and shadow.*

Why is it important for butterflies to see ultraviolet light?

*Certain colors and patterns are revealed only under UV light, such as nectar paths, which direct butterflies to the source of nectar in a flower, and patterns that help butterflies identify potential mates.*

How do simple eyes help butterflies migrate?

*They are sensitive to light and sense the sun's position, letting the butterfly determine which direction it is facing.*

**Taste**

Butterflies can taste with their feet. Why is this an important adaptation?

*Females can determine if they've landed on the right host plant for laying their eggs by tasting the surface. Butterflies can also detect sugar when they land on nectar plants.*

What is the proboscis of a butterfly? Do you see any butterflies using their proboscises?

*It is the tube-like, sucking mouth part with which the adults drink nectar. It is coiled up beneath the head when not being used. Answers will vary.*

Do you see any caterpillars eating? If so, describe what you see.

*Answers will vary. Caterpillars have jaws/chewing mouth parts for eating leaves.*

**Smell**

What do you smell in the conservatory (butterfly garden)? Describe how butterflies would smell these scents.

*Answers will vary. Butterflies smell mainly with (chemoreceptors on) their antennae.*

**Hearing**

Do you think that butterflies can hear you? What evidence do you see that they can or cannot hear?

*Answers will vary. Butterflies don't have ears; they can sense vibrations through their bodies and wings (through the setae) and may respond to very loud or sudden sounds.*

**Touch**

What do you see butterflies touching in the conservatory?

*Answers will vary. Butterflies have setae (sensory hairs) all over their body to feel the environment. Some species may also use their antennae to touch objects/one another.*

After your visit to the Academy, think about the many ways in which butterflies use their senses. List as many ways as possible:

*To find food, to find mates/ identify other butterflies of their species, to lay eggs in an appropriate place, to migrate, to avoid predators, to, to balance/fly, to sense the sun, to sense changes in day length/seasons*

## Rubric 9.4 for Student Handout 9.4

## Adaptations/Senses

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	2 – Approaching Standards	1 – Below Standards	Score
<b><u>Answers</u></b>	All of the answers are clearly supported with specific examples that are relevant to the question.	Most of the answers are clearly supported with specific examples that are relevant to the question.	At least two of the answers are clearly supported with specific examples that are relevant to the question.	Answers are not clearly supported with specific examples and/or are not relevant to the question.	
<b><u>Accuracy</u></b>	All supportive facts are reported accurately.	Almost all supportive facts are reported accurately.	Most supportive facts are reported accurately.	Most supportive facts are inaccurately reported.	
<b><u>Sentence Structure</u></b>	All sentences are well-constructed with varied structure.	Most sentences are well-constructed and there is some varied sentence structure in the essay.	Most sentences are well constructed, but there is no variation in structure.	Most sentences are not well-constructed or varied.	
<b><u>Grammar &amp; Spelling</u></b>	Author makes no errors in grammar or spelling that distract the reader from the content.	Author makes 1-2 errors in grammar or spelling that distract the reader from the content.	Author makes 3-4 errors in grammar or spelling that distract the reader from the content.	Author makes more than 4 errors in grammar or spelling that distract the reader from the content.	

## Rubric 9.R for Reflection Paragraph

## Adaptations/Senses

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	3 – Meets Standards	1 – Below Standards	Score
<b><u>Focus or Thesis Statement</u></b>	The thesis statement names the topic of the paragraph and outlines the main points to be discussed.	The thesis statement names the topic of the paragraph.	The thesis statement outlines some or all of the main points to be discussed but does not name the topic.	The thesis statement does not name the topic AND does not preview what will be discussed.	
<b><u>Accuracy</u></b>	All supportive facts are reported accurately.	Almost all supportive facts are reported accurately.	Most supportive facts are reported accurately.	Most supportive facts are inaccurately reported.	
<b><u>Sentence Structure</u></b>	All sentences are well-constructed with varied structure.	Most sentences are well-constructed and there is some varied sentence structure.	Most sentences are well constructed, but there is no variation in structure.	Most sentences are not well-constructed or varied.	
<b><u>Grammar &amp; Spelling</u></b>	Author makes no errors in grammar or spelling that distract the reader from the content.	Author makes 1-2 errors in grammar or spelling that distract the reader from the content.	Author makes 3-4 errors in grammar or spelling that distract the reader from the content.	Author makes more than 4 errors in grammar or spelling that distract the reader from the content.	

**Target:** 5-8<sup>th</sup> Grade

**Duration:** One 45-minute lesson w/extension options and parent links

**Discipline Connections:** Science, Math, English, Visual Arts, Technology

**Before Lesson/Materials:** Copies of Student Handout 10.1, Rubric 10.1, and Rubric 10.R for each student

**Word Bank:** Sense, Adaptation, Migration, Predator, Ocelli, Compound Eyes, Tactile, Setae, Antennae, Sense Receptor (Chemoreceptor, Photoreceptor), Proboscis, Pheromone, Tarsi, Ovipositor, Exoskeleton

**Objective:** Students will demonstrate their ability to identify the parts of the body that butterflies and caterpillars use in conjunction with their senses.

**Background:** In this lesson, students will complete a reading with processing questions about the senses of butterflies and caterpillars. Students will also create a poster that diagrams each of the butterfly and caterpillar parts related to the senses.

**Focusing Question:** Imagine that you had to taste with your feet. Explain the process of food shopping, cooking, and eating a meal using only your feet to taste your ingredients. You may choose any meal that you want.

**Procedure:**

1. Have students respond in writing to the focusing question. Select a few students to share highlights from their responses.
2. Explain that students will learn about the senses of a caterpillar and an adult butterfly, and how each uses its senses to understand the world around it.
3. State the lesson's objective and write the objective on the board.
4. Hand out Student Handout 10.1 and Rubric 10.1.
5. Read the handout as a whole group or in small groups. Students should pause to answer processing questions while reading; ask students to share out to ensure accuracy of their answers.
6. Have students create a poster with a diagram of a butterfly or caterpillar. Make sure that students use labels and captions to explain how and why each body part connects with the senses.

**Reflection:** Distribute Rubric 10.R. Have students respond to the following story prompt: You are a female butterfly and you have just awakened. You realize that one of your senses is not functioning properly. You are worried because you have a big day ahead of you. You need to locate nectar and track down your boyfriend (another butterfly from your species). You also need to find a good host plant to lay your eggs on. Which sense is not working? What will you do? How will you lay your eggs?

**Assessment:** Completed Student Handout 10.1, poster activity, Reflection Paragraph

### **Extension Options:**

- Read the book entitled Moths, Butterflies, Other Insects, and Spiders: Science in Art, Song, and Play (Science in Every Sense) by Rhonda Vansant, Barbara L. Dondiego, Claire Kalish (Illustrator) (published by Tab Books, ISBN# 0070179077), and have students identify senses of creatures similar to butterflies.
- Have students conduct research and create a Venn Diagram to compare and contrast a butterfly's senses with those of another animal or insect.
- Have students create an imaginary creature with a sensory system unlike a butterfly.
- Have students create a costume to wear to class that shows all of a butterfly's parts that are important to its senses.

### **Parent-Links:**

- Design an experiment to explore your senses. Try eating foods with your nostrils pinched closed, or playing music with ear plugs in or wearing a blindfold. Can you feel the music vibrations? Can you identify the song? How does smell affect your sense of taste?
- Visit the following webquest to research how butterflies use their bodies to communicate:  
<http://www.teachers.ash.org.au/jmresources/butbodyparts/4act.html>

### **Resources:**

- <http://www.learner.org/jnorth/search/Monarch.html>
- <http://www.teachers.ash.org.au/jmresources/butbodyparts/4act.html>
- <http://www.animalden.net/ai/bug/butterfly/butterfly-faq.htm>
- <http://www.amazingbutterflies.com/frequentlyaskedquestions.htm>
- [http://projects.edtech.sandi.net/brooklyn/butterflies/funny\\_facts.htm](http://projects.edtech.sandi.net/brooklyn/butterflies/funny_facts.htm)
- [http://www.fieldmuseum.org/butterfly/amaz\\_basic2.htm](http://www.fieldmuseum.org/butterfly/amaz_basic2.htm)
- <http://www.enchantedlearning.com/subjects/butterfly/allabout/Senses.shtml>

### **Standards:**

***Philadelphia City Standards:*** Reading 1, 2, 3; Writing 1, 2, 3; Speaking 1, Listening 1; Science 1, 4, 5, 6; Math 6; Art 1, 7

***Pennsylvania State Standards:*** Reading, Writing, Speaking, Listening 1.1, 1.2, 1.4, 1.5, 1.6, 1.8; Science and Technology 3.3.A and B, 3.6B, 3.7C and E; Family and Consumer Sciences 11.2H; Math 2.4, 2.5, Art 9.1B, I, J, and K; Environment and Ecology 4.7B

Butterflies perceive the world quite differently than humans do. Although we have some senses in common, they may not be used in exactly the same way. For instance, butterflies smell even though they don't have noses, and they can see things that people can't! It may be hard for us to understand all the things that butterflies sense, since we can only know what our own five senses tell us. Butterflies use their senses to find food, to identify and communicate with mates, to locate the right plants on which to lay their eggs, to avoid predators and other dangers, and to move from place to place.

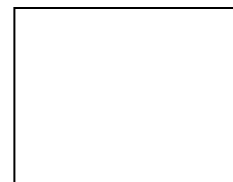
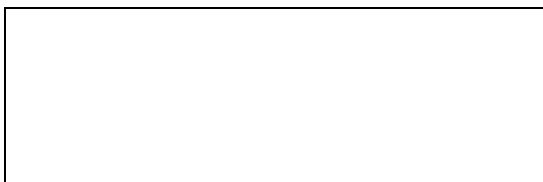
**SIGHT**

Caterpillars do not have very good vision. They have “simple eyes”, also called ocelli. These are made up of photoreceptors, nerve cells that are sensitive to light. Ocelli do not see images, but they can sense light and shadow. This is important because light levels shift as storms approach, seasons and the length of daylight change, or large predators get close. Caterpillars typically have twelve ocelli, six on each side of the head, but different species may have fewer.

Adult butterflies have two “compound eyes”. These large, rounded eyes are made up of thousands of tiny, hexagon-shaped units. They are able to see in almost all directions at once, because each individual unit has a lens that senses its own visual information. We cannot know exactly what an image looks like to butterflies after their brains combine and interpret all this information. Butterflies are probably pretty near-sighted (that is, they only see well when they are close to something). We know that compound eyes are excellent at detecting movement and color, which is important for sensing predators, finding and communicating with mates, and locating food plants.

Butterflies see many of the same colors that people do, such as yellows, reds, oranges, pinks, and purples. However, they also perceive ultraviolet (UV) light, which is invisible to people. Colors or patterns that can be seen only under UV light may guide butterflies to the nectar in a flower or help them recognize an appropriate mate. Butterflies detect polarized light, too (that is, they can tell in which direction light is moving). In addition to compound eyes, adult butterflies also have a few ocelli. These simple eyes sense the sun's position. This helps migrating butterflies determine in which direction they are flying.

**Students:** In the first space below, draw a caterpillar's head with six ocelli on each side of its head. Use the second space to draw the shape of one unit in an adult butterfly's compound eye.



**Students:** The sentences below are either true or false. **Circle** the correct answer:

- 1) Caterpillars and adult butterflies both have simple eyes.      True      or      False
- 2) Caterpillars see images and colors.      True      or      False
- 3) Butterflies see colors that people cannot.      True      or      False

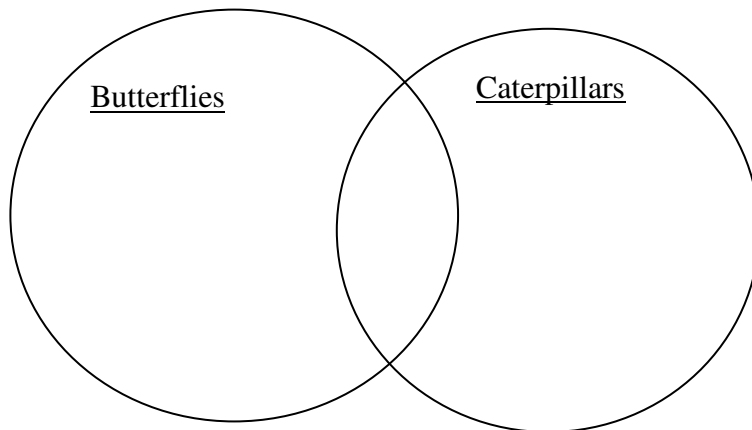
**SMELL AND TASTE**

Caterpillars and butterflies smell and taste with chemoreceptors that are located on various parts of their bodies. These are special nerve cells sensitive to different chemicals. Humans have similar receptors in our noses and on our tongues (our “taste buds”). “Tastes” are chemicals encountered on contact with a liquid or solid. “Smells” are scents - chemicals in the air. Caterpillars use taste and smell to make sure they are eating the right foods. They have taste receptors on parts of their mouths called palps and maxillae. Tiny antennae near their mouths may detect smells or tastes as well.

Adult butterflies primarily smell with their antennae, although a few other body parts can detect specific odors as well. Receptors all over the antennae and especially on its tip are extremely sensitive to pheromones and plant scents. Pheromones are airborne chemicals produced by one gender to attract members of the opposite sex (depending on species, either sex may produce them). Butterflies locate both nectar and larval food plants by tracking scents, which they can detect from quite a distance. Taste is then used to confirm whether a plant is appropriate food.

Butterflies taste with their feet and legs. When a female butterfly lands on a leaf to lay eggs, she beats her feet, or tarsi, against the plant to release some of its juices. Chemoreceptors along her legs taste the juices to make sure she has landed on the right host plant for her young to eat. If the taste is wrong, she will not lay her eggs on that plant. Some females even have taste sensors on the ovipositor (the structure with which they lay eggs) to confirm they are on the correct host plant. Both males and females also have receptors in their tarsi that respond to contact with sugar. The proboscis (the tube-like mouth part) uncoils automatically when a butterfly’s feet touch a nectar plant. Various parts of the mouth, including the proboscis and palps, taste sugar as well.

**Students:** Use this Venn Diagram to compare how butterflies and caterpillars smell/taste. Remember that the differences between the two groups go on the side of either circle, and the similarities are written in the space where both circles meet.



**HEARING AND TOUCH**

Caterpillars and the majority of butterflies do not have anything resembling an ear. They do not “hear” in the way people do. Instead, they “feel” sound, by sensing vibrations. Their bodies are covered with tactile setae, which grow through the exoskeleton. These are special hairs or bristles attached to nerve cells that are sensitive to touch.

Many caterpillars look fuzzy because they have setae scattered across their bodies and faces. These sensory hairs enable them to feel their environment and also sense sudden air movements resulting from sharp noises. Many caterpillars will react to something touching them directly by curling up or falling away. Some species respond in a similar way to loud sounds, by rearing up or dropping from their branches. They do not react to softer sounds or ongoing noises. This suggests the behaviors developed as a defense against a suddenly-appearing predator.

Adult butterflies also have setae everywhere. They sense touch as well as vibrations along their wings, bodies, and faces. A few species have a kind of “simple ear”, similar to an eardrum, that hears certain sound frequencies. It is a thin membrane stretched over a small hole containing sensory nerves that can be located near the base of the wings. However, most butterflies are essentially deaf, detecting vibrations from only very loud sounds.

Adult butterflies can use their antennae to touch objects or other butterflies. This is done more in some species than others. They also use their antennae to maintain balance while flying. They do this by “feeling” the air, sensing things like wind movement and gravity. Setae also help a butterfly to balance itself by letting it feel the positions of its different body parts.

**Students:** Answer using the space below. Why do you think that most butterflies and caterpillars don’t rely much on hearing for communication or survival?

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**Students:** In the space below, draw a body part that adult butterflies use both to touch and to smell.





Butterflies perceive the world quite differently than humans do. Although we have some senses in common, they may not be used in exactly the same way. For instance, butterflies smell even though they don't have noses, and they can see things that people can't! It may be hard for us to understand all the things that butterflies sense, since we can only know what our own five senses tell us. Butterflies use their senses to find food, to identify and communicate with mates, to locate the right plants on which to lay their eggs, to avoid predators and other dangers, and to move from place to place.

**SIGHT**

Caterpillars do not have very good vision. They have “simple eyes”, also called ocelli (pronounced ah-SELL-ee). These are made up of photoreceptors, nerve cells that are sensitive to light. Ocelli do not see images, but they can sense light and shadow. This is important because light levels shift as storms approach, seasons and the length of daylight change, or large predators get close. Caterpillars typically have twelve ocelli, six on each side of the head, but different species may have fewer.

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**Students:** In the first space below, draw a caterpillar's head with six ocelli on each side of its head. Use the second space to draw the shape of one unit in an adult butterfly's compound eye.

*If students draw a side-view, there should be only six eyes (dots, circles, etc.). If they draw a frontal view, there should be six on either side of the face.*

*This should be a hexagon (six sided shape).*

**Students:** The sentences below are either true or false.  Circle the correct answer:

- 4) Caterpillars and adult butterflies both have simple eyes.
- 5) Caterpillars see images and colors.
- 6) Butterflies see colors that people cannot.

True or  False  
 True or  False  
 True or  False

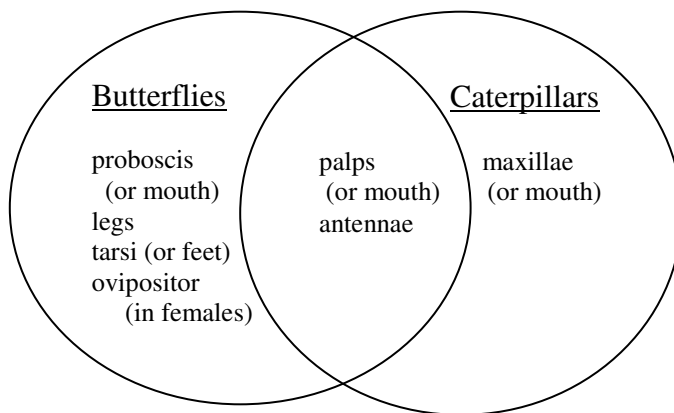
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Adult butterflies primarily smell with their antennae, although a few other body parts can detect specific odors as well. Receptors all over the antennae and especially on its tip are extremely sensitive to pheromones and plant scents. Pheromones are airborne chemicals produced by one gender to attract members of the opposite sex (depending on species, either sex may produce them). Butterflies locate both nectar and larval food plants by tracking scents, which they can detect from quite a distance. Taste is then used to confirm whether a plant is appropriate food.

Butterflies taste with their feet and legs. When a female butterfly lands on a leaf to lay eggs, she beats her feet, or tarsi, against the plant to release some of its juices. Chemoreceptors along her legs taste the juices to make sure she has landed on the right host plant for her young to eat. If the taste is wrong, she will not lay her eggs on that plant. Some females even have taste sensors on the ovipositor (the structure with which they lay eggs) to confirm they are on the correct host plant. Both males and females also have receptors in their tarsi that respond to contact with sugar. The proboscis (the tube-like mouth part) uncoils automatically when a butterfly’s feet touch a nectar plant. Various parts of the mouth, including the proboscis and palps, taste sugar as well.

**Students:** Use this Venn Diagram to compare how butterflies and caterpillars smell/taste. Remember that the differences between the two groups go on the side of either circle, and the similarities are written in the space where both circles meet.



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Caterpillars and the majority of butterflies do not have anything resembling an ear. They do not “hear” in the way people do. Instead, they “feel” sound, by sensing vibrations. Their bodies are covered with tactile setae (SEH-tee), which grow through the exoskeleton. These are special hairs or bristles attached to nerve cells that are sensitive to touch.

Many caterpillars look fuzzy because they have setae scattered across their bodies and faces. These sensory hairs enable them to feel their environment and also sense sudden air movements resulting from sharp noises. Many caterpillars will react to something touching them directly by curling up or falling away. Some species respond in a similar way to loud sounds, by rearing up or dropping from their branches. They do not react to softer sounds or ongoing noises. This suggests the behaviors developed as a defense against a suddenly-appearing predator.

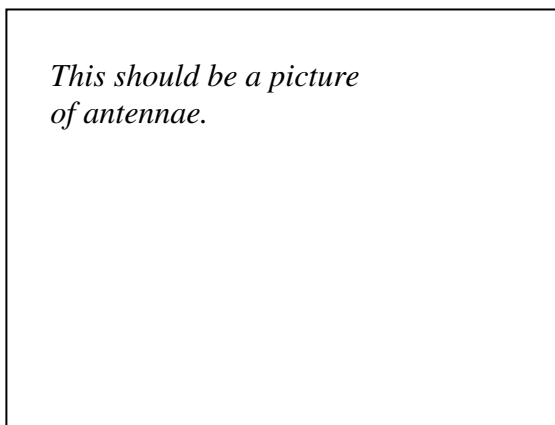
Adult butterflies also have setae everywhere. They sense touch as well as vibrations along their wings, bodies, and faces. A few species have a kind of “simple ear”, similar to an eardrum, that hears certain sound frequencies. It is a thin membrane stretched over a small hole containing sensory nerves that can be located near the base of the wings. However, most butterflies are essentially deaf, detecting vibrations from only very loud sounds.

Adult butterflies can use their antennae to touch objects or other butterflies. This is done more in some species than others. They also use their antennae to maintain balance while flying. They do this by “feeling” the air, sensing things like wind movement and gravity. Setae also help a butterfly to balance itself by letting it feel the positions of its different body parts.

**Students:** Answer using the space below. Why do you think that most butterflies and caterpillars don’t rely much on hearing for communication or survival?

\_\_\_\_\_ *They don’t have ears and are mostly deaf. They can survive without hearing* \_\_\_\_\_  
 \_\_\_\_\_ *because of their other senses. They are able to feel what’s going on around them* \_\_\_\_\_  
 \_\_\_\_\_ *with their setae (hairs). In the sunlight, they can communicate easily by sight.* \_\_\_\_\_  
 \_\_\_\_\_ *They also rely on smell and taste.* \_\_\_\_\_

**Students:** In the space below, draw a body part that adult butterflies use both to touch and to smell.



## Rubric 10.1 for Student Handout 10.1 and Poster

## Adaptations/Senses

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	2 – Approaching Standards	1 – Below Standards	Score
<b><u>Drawings/ Diagrams</u></b>	Clear, accurate diagrams are included. Diagrams are labeled neatly and accurately.	Diagrams are included and are labeled neatly and accurately.	Diagrams are included and are labeled.	Needed diagrams are missing OR are missing important labels.	
<b><u>Components of the Handout</u></b>	All required elements are present and additional elements that add to the handout (e.g., thoughtful comments, graphics) have been added.	All required elements are present.	One required element is missing, but additional elements that add to the handout (e.g., thoughtful comments, graphics) have been added.	Several required elements are missing.	
<b><u>Written Responses</u></b>	Answers describe the skills learned, the information learned and some future applications to real life situations.	Answers describe the information learned and a possible application to a real life situation.	Answers describe the information learned.	No answer is written.	
<b><u>Spelling, Punctuation and Grammar</u></b>	One or fewer errors in spelling, punctuation or grammar in the report.	Two or three errors in spelling, punctuation or grammar in the report.	Four errors in spelling, punctuation or grammar in the report.	More than 4 errors in spelling, punctuation or grammar in the report.	

## Rubric 10.R for Butterfly Story Reflection

## Adaptations/Senses

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	2 – Approaching Standards	1 – Below Standards	Score
<b><u>Focus on Assigned Topic</u></b>	The entire story is related to the assigned topic and allows the reader to understand much more about the topic.	Most of the story is related to the assigned topic. The story wanders off at one point, but the reader can still learn something about the topic.	Some of the story is related to the assigned topic, but a reader does not learn much about the topic.	No attempt has been made to relate the story to the assigned topic.	
<b><u>Creativity</u></b>	The story contains many creative details and/or descriptions that contribute to the reader's enjoyment. The author has really used his imagination.	The story contains a few creative details and/or descriptions that contribute to the reader's enjoyment. The author has used his imagination.	The story contains a few creative details and/or descriptions, but they distract from the story. The author has tried to use his imagination.	There is little evidence of creativity in the story. The author does not seem to have used much imagination.	
<b><u>Problem/Conflict</u></b>	It is very easy for the reader to understand the problem the main characters face and why it is a problem.	It is fairly easy for the reader to understand the problem the main characters face and why it is a problem.	It is fairly easy for the reader to understand the problem the main characters face, but it is not clear why it is a problem.	It is not clear what problem the main characters face.	
<b><u>Organization</u></b>	The story is very well organized. One idea or scene follows another in a logical sequence with clear transitions.	The story is pretty well organized. One idea or scene may seem out of place. Clear transitions are used.	The story is a little hard to follow. The transitions are sometimes not clear.	Ideas and scenes seem to be randomly arranged.	

**Target:** 5<sup>th</sup>-8<sup>th</sup> Grade

**Duration:** One 45-minute lesson w/ extension options and parent links

**Discipline Connections:** Science, English, Visual Arts, Technology, Geography, Math

**Before the Lesson/ Materials:** Copies of Student Handout 11.1, 11.2, and 11.3 (optional), and Rubrics 11.1, 11.3 (optional), and 11.R for each student; set up computer projector for web video

**Word Bank:** Adaptation, Defense, Predator, Mimicry, Camouflage, Deception, Eyespot, Warning Coloration

**Objective:** Students will demonstrate their understanding of how animals defend themselves against getting eaten. They will learn that organisms have special adaptations that help them escape predators and stay alive.

**Background:** All animals have adaptations that help them protect themselves from predators and survive. Butterflies use a variety of defenses to stay alive, including flying away, camouflage, mimicry, and chemical defenses.

**Focusing Question:** What are some things in your environment that you need to protect yourself from? What are some adaptations that you have developed to protect yourself from your environment?

**Procedure:**

1. Distribute Student Handout 11.1 and Rubric 11.1.
2. Have students respond in writing to the focusing question and select a few students to share highlights from their responses.
3. State the lesson's objective and write the objective on the board.
4. Have students watch the Animal Defenses Quick Time Video at the following website: <http://www.teachersdomain.org/K-2/sci/life/colt/defense/index.html>  
*In case Internet access is not available, a reading can be obtained from this site.*
5. Have students answer the questions about the video on Student Handout 11.1.
6. Select a few students to share their answers and make any necessary clarifications.
7. Distribute Student Handout 11.2 and have students read it. Students should then answer the questions about this reading on Handout 11.1. If you have students that are significantly below level, use this handout as a Shared Reading.<sup>1</sup>
8. Select a few students to share their answers and make any necessary clarifications.

**Museum Activities (optional):**

9. At the Academy's *Butterflies!* exhibit, students will observe several defenses that butterflies use to protect themselves.
10. Distribute Student Handout 11.3 and Rubric 11.3.

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<sup>1</sup> During a Shared Reading the teacher reads the text aloud while the students follow along. The teacher models good reading strategies and may pause to ask questions to ensure student engagement.

**Reflection:**

Have students review what they learned about butterfly defenses and write a paragraph describing why butterflies need to protect themselves and how they do it. Tell students to use specific examples learned from class to support their ideas. Distribute Rubric 11.R.

**Assessment:**

Completed Student Handout 11.1, Student Handout 11.3, and Reflection Paragraph

**Extension Options:**

- Have students read the article “On the Menu” at the following website:  
<http://magma.nationalgeographic.com/ngexplorer/0503/articles/mainarticle.html>  
They can also play the game “Staying Alive” at:  
[http://magma.nationalgeographic.com/ngexplorer/0503/games/game\\_intro.html](http://magma.nationalgeographic.com/ngexplorer/0503/games/game_intro.html)  
They can complete a word search, “Animal Escape Artists,” at:  
<http://magma.nationalgeographic.com/ngexplorer/0503/wordwise/>
- Have students read Animal Defenses: How Animals Protect Themselves, by Etta Kaner, Pat Stephens (Illustrator) (published by Kids Can Press, ISBN #1550744216) to a lower level class. Then have students prepare a short presentation about how butterflies defend themselves. They may use chart paper to list important facts and pictures.
- Have students create their own 3-D imaginary organism with household materials. They should include a short report to accompany their model which includes: where the organism lives, how it gets food and water, and how it defends itself against predators. They should discuss what kinds of predators it has.
- Discuss predator and prey relationships in further detail. Have students consider the importance of predators to the environment. The *Strange Days on Planet Earth* project offers an activity guide with a topic on predators:  
<http://www.pbs.org/strangedays/educators/>

**Parent-Links:**

- Have students make a journal of butterfly defenses in which they keep a list of the different ways that they observe butterflies protecting themselves. They should focus on the following four strategies: getting away, hiding, deception, and chemical defenses. They should make sketches and write observations of what they observe.

**Resources:**

- <http://www.enchantedlearning.com/subjects/butterfly/allabout/Defense.shtml>
- <http://www.Monarchwatch.org/biology/pred1.htm>
- <http://www.teachersdomain.org/K-2/sci/life/colt/defense/index.html>
- <http://magma.nationalgeographic.com/ngexplorer/0503/articles/mainarticle.html>
- <http://www.pbs.org/strangedays/educators/>

**Standards:**

**Philadelphia City Standards:** Reading 1,2,3; Writing 1,2,3; Speaking 1; Listening 1; Science 1,3,4,5; Math 6; Arts 1,7

**Pennsylvania State Standards:** Reading, Writing, Speaking, Listening 1.1,1.2,1.4,1.5,1.6,1.8; Science and Technology 3.1A and E, 3.3A-B, 3.6B, 3.7 C,E; Family and Consumer Sciences 11.2H; Math 2.4, 2.5; Art 9.1 B, I, J, and K, Environment and Ecology 4.5A, 4.7B

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Focusing Question:

What are some things in your environment that you need to protect yourself from? What are some adaptations you have or other tools you use to protect yourself from your environment?

*Remember: An **adaptation** is a physical or behavioral characteristic that helps an organism survive and reproduce in its environment.*

After watching the Animal Defenses video and reading the background article from the web site, answer the following questions.

1. What is a **predator**?
  
  
  
  
  
  
  
  
  
  
2. Various physical and behavioral strategies for survival were discussed in the video. These included getting away from danger (by fleeing or hiding), deceiving a predator (pretending to be something the animal is not), and using chemical or physical “weapons”. List at least two ways in which animals from the video used each of these strategies:
  - a. **Fleeing/hiding-**
  
  
  
  
  
  
  
  
  
  
  - b. **Deception-**
  
  
  
  
  
  
  
  
  
  
  - c. **Chemical/Physical Defenses-**



Read about butterflies' adaptations for survival in Student Handout 11.2 and answer the following questions.

1. What do caterpillars and butterflies have to protect themselves from?
2. How do caterpillars and butterflies **flee**?
3. How do caterpillars and butterflies **hide**?
4. How do caterpillars and butterflies **deceive** their predators?
5. What are some of caterpillars' and butterflies' **chemical defenses**?
6. Which of these butterfly defenses do you find the most interesting? Why?

**Focusing Question:**

What are some things in your environment that you need to protect yourself from? What are some adaptations you have or other tools you use to protect yourself from your environment?

*Remember: An **adaptation** is a physical or behavioral characteristic that helps an organism survive and reproduce in its environment.*

*Answers will vary. Some examples of threats (and defensive adaptations/tools): the sun (hair/sunscreen, hat, parasol), rain (raincoat, umbrella), cold temperatures (shivering/ warm clothing), heat (sweating/ fan, AC), dangerous animal/person (scream, hide, run away, fight, stay in groups/ weapons), getting sick (immune system/ vitamins, medicine), etc.*

After watching the Animal Defenses video and reading the background article from the web site, answer the following questions.

1. What is a predator?

*A predator is an animal that kills and eats another animal.*

2. Various physical and behavioral strategies for survival were discussed in the video. These included getting away from danger (by fleeing or hiding), deceiving a predator (pretending to be something the animal is not), and using chemical or physical “weapons”. List at least two ways in which animals from the video use each of these strategies:

**a. Fleeing/hiding-**

*porcupine runs away, squid swims away, puffer fish swims away, turtle can hide in shell and camouflage itself with the ground*

**b. Deception –**

*puffer fish expands its body to make itself look larger and more intimidating, snake tries to look dangerous, snake pretends to be dead*

**c. Chemical/Physical Defenses-**

*snake emits a bad-smelling chemical, squid squirts ink to confuse predators and disappear more quickly, porcupine raises sharp quills, rhinoceros uses sharp horns, crab displays strong claws, puffer fish has prickles*

Read about butterflies' adaptations for survival in Student Handout 11.2 and answer the following questions.

1. What do caterpillars and butterflies have to protect themselves from?  
*Predators (including birds, small mammals, reptiles, wasps, flies, spiders, mites, other caterpillars, etc.), parasites; also, environmental conditions (including weather, space constraints, food limitations, etc.)*
2. How do caterpillars and butterflies **flee**?  
*Caterpillars cannot get away quickly, so they depend on other defenses. Butterflies use their wings to fly away; they may fly erratically.*
3. How do caterpillars and butterflies **hide**?  
*Some caterpillars hide within a folded leaf, some caterpillars camouflage (conceal or disguise themselves by their colors) with their host plants. Some butterflies camouflage themselves, for example Indian Leaf butterfly looks like a dead leaf, and Carpenter moth looks like bark of a tree*
4. How do caterpillars and butterflies **deceive** their predators?  
*Some caterpillars have eyespots that make them look like a snake or other larger animal. Some look like bird droppings (like some Swallowtails). Some butterflies imitate another butterfly that is poisonous (this is called mimicry) by having similar colors/patterns – these mimics may or may not also be poisonous. For example, the Viceroy and the Queen both mimic the poisonous Monarch butterfly.*
5. What are some **chemical defenses** used by caterpillars and butterflies?  
*Some caterpillars are poisonous (like the Pipevine Swallowtail and Monarch). Some caterpillars emit bad smells (like the Zebra Swallowtail). Some butterflies are also poisonous (for example, the Monarch butterfly, Goliath Birdwing, Small Postman butterfly, or Pipevine Swallowtail). They eat toxic plants to become poisonous.*
6. Which of these butterfly defenses do you find the most interesting? Why?  
*Answers will vary.*

## Rubric 11.1 for Student Handout 11.1

## Adaptations/Defenses

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	2 – Approaching Standards	1 – Below Standards	Score
<b><u>Answers</u></b>	All of the answers are clearly supported with specific examples that are relevant to the question.	Most of the answers are clearly supported with specific examples that are relevant to the question.	At least two of the answers are clearly supported with specific examples that are relevant to the question.	Answers are not clearly supported with specific examples and/or are not relevant to the question.	
<b><u>Accuracy</u></b>	All supportive facts are reported accurately.	Almost all supportive facts are reported accurately.	Most supportive facts are reported accurately.	Most supportive facts are inaccurately reported.	
<b><u>Sentence Structure</u></b>	All sentences are well-constructed with varied structure.	Most sentences are well-constructed and there is some varied sentence structure.	Most sentences are well constructed, but there is no variation in structure.	Most sentences are not well-constructed or varied.	
<b><u>Grammar &amp; Spelling</u></b>	Author makes no errors in grammar or spelling that distract the reader from the content.	Author makes 1-2 errors in grammar or spelling that distract the reader from the content.	Author makes 3-4 errors in grammar or spelling that distract the reader from the content.	Author makes more than 4 errors in grammar or spelling that distract the reader from the content.	

# Caterpillar and Butterfly Defense Mechanisms

Downloaded with permission from:

<http://www.enchantedlearning.com/subjects/butterfly/allabout/Defense.shtml>

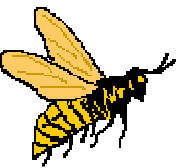
## Caterpillars



Caterpillars are soft bodied and slow moving. This makes them easy prey for predators, like birds, wasps, and mammals to mention just a few. Some caterpillars are even eaten by their fellow caterpillars (like Zebra swallowtail larva which are cannibalistic).

In order to protect themselves from predators, caterpillars use different strategies, including:

- **Poison** Some caterpillars are poisonous to predators. These caterpillars get their toxicity from the plants they eat. Generally, the brightly colored larvae are poisonous; their color is a reminder to predators about their toxicity. Some poisonous caterpillars include the Monarch and the Pipevine Swallowtail.
- **Camouflage** Some caterpillars blend into their surroundings extraordinarily well. Many are a shade of green that matches their host plant. Others look inedible objects, like bird droppings (the young Tiger Swallowtail larva).
- **Eyespots** Some caterpillars have eyespots that make them look like a bigger, more dangerous animal, like a snake. An eye spot is a circular, eye-like marking found on the body of some caterpillars. These eyespots make the insect look like the face of a much larger animal and may scare away some predators.
- **Hiding** Some caterpillars encase themselves in a folded leaf or other hiding place.
- **Bad smells** Some caterpillars can emit very bad smells to ward off predators. They have an osmeterium, an orange, y-shaped gland on their neck which gives off a strong, unpleasant odor when the caterpillar is threatened. This keeps away dangerous wasps and flies that try to lay eggs in the caterpillar; these eggs would eventually kill the caterpillar as they hatch inside its body and eat its tissues. Many swallowtails have an osmeterium, including the Zebra Swallowtail.



## Butterflies

Butterflies are fragile and almost defenseless creatures. They rely on a variety of strategies to protect them from hungry predators. Their predators include birds, spiders, reptiles, other invertebrates (e.g., wasps, flies, and mites), and small mammals.

**CAMOUFLAGE**

Most butterflies and moths protect themselves from predators by using camouflage. Some butterflies and moths blend into their environment so well that it is almost impossible to spot them when they are resting on a branch. Some butterflies look like dead leaves (like the Indian Leaf butterfly), others look like the bark of a tree (e.g., the Carpenter Moth).

**POISON**

Some butterflies are poisonous. When a predator, like a bird, eats one of these butterflies it becomes sick, vomits violently, and quickly learns not to eat this type of butterfly. The sacrifice of one butterfly will save the lives of many of its kind (and other species that look like it - see the section on mimicry below).

Many poisonous species have similar markings (warning patterns). When a predator learns this pattern (after becoming sick from eating one species), many species with similar patterns will be avoided in the future.

Some poisonous butterflies include the Monarch (which eats the milkweed plant to become poisonous), the Small Postman butterfly, and the Pipevine Swallowtail.

**MIMICRY**

Mimicry is when two unrelated species have similar markings.

**Batesian mimicry** is when a non-poisonous species has markings similar to a poisonous species and gains protection from this similarity. Since many predators have become sick from eating the poisonous butterfly, they will avoid any similar looking animals in the future, and the mimic is protected.

**Müllerian mimicry** is when two poisonous species have similar markings; fewer insects need to be sacrificed in order to teach the predators not to eat these unpalatable animals. Tropical Queens and [Monarch butterflies](#) are two poisonous butterflies that have similar markings. Another example is the poisonous Viceroy which mimics the poisonous [Monarch butterfly](#).

**FLYING**

Flying is one of the main defenses of butterflies. The speed varies among butterfly species (the poisonous varieties are slower than non-poisonous varieties). The fastest butterflies (some skippers) can fly at about 30 mile per hour or faster. Slower butterflies fly about 5 mph.



The Goliath Birdwing is a poisonous butterfly from Indonesia. Its bright colors remind any experienced predators (those who ate one in the past and became sick) that it tastes very bad.

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**Word Bank:** Unpalatable- unpleasing to taste

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Today you will be participating in a scavenger hunt to locate different butterfly defenses in the Academy's *Butterflies!* exhibit.

**Getting Away**

You will see butterflies flying in the conservatory (butterfly garden). Do you think they are flying away from predators? Why or why not?

**Deception**

Can you find a butterfly that looks like another animal? If so, what is it called? What do you think it is trying to mimic? Sketch the butterfly:

Can you find a butterfly that may fool a predator into attacking the wrong part of its body? If so, what is it called? How is the predator tricked?

Can you find any two butterflies that are mimicking each other's coloration? If so, describe which butterflies they are and the patterns they share:

**Hiding**

Can you find a butterfly that camouflages (blends in) really well with the surrounding plants? If so, what is it called? Describe its camouflage colors or pattern:

Can you find a butterfly that has different colors on top of its wings and on the bottom of its wings? If so, what is it called? Why do you think this is a good way for the butterfly to survive in its environment?

Can you find any other organisms at the Academy that are camouflaged with their environment?

**Chemical Defenses**

Can you find any butterflies with bright warning colors? If so, what colors do you see? What do you think the butterfly is warning against?

**Getting Away**

You will see butterflies flying through the conservatory (butterfly garden). Do you think they are flying away from predators? Why or why not?

*Answers will vary. Butterflies in the conservatory are usually NOT disturbed by human presence. Most flight is a result of butterflies travelling between food sources or chasing one another.*

**Deception**

Can you find a butterfly that looks like another animal? If so, what is it called? What do you think it is trying to mimic? Sketch the butterfly:

*Answers will vary. Some butterflies have big eye spots or other patterns that make them look like larger or dangerous animals. Owl butterfly mimics an owl's eyes; Atlas moth mimics a snake's head; body of the Clipper butterfly looks like a bee or wasp (yellow and black stripes), etc.*

Can you find a butterfly that may fool a predator into attacking the wrong part of its body? If so, what is it called? How is the predator tricked?

*Answers will vary. Some butterflies have eye spots, "tails", bright markings, etc. on parts of their bodies that draw attention away from their sensitive heads; predators are distracted long enough for the butterfly to escape. Examples: various Swallowtail species, Mormon butterflies*

Can you find any two butterflies that are mimicking each other's coloration? If so, describe which butterflies they are.

*Answers will vary. Some examples: the female Black Swallowtail mimics the Pipevine Swallowtail, the Viceroy mimics the Monarch, etc.*

**Hiding**

Can you find a butterfly that camouflages (blends in) really well with the surrounding plants? If so, what is it called? Describe its camouflage colors or pattern:

*Answers will vary. Leaf butterflies look like dead leaves, Cracker butterflies look like bark, many species are mottled or dappled browns or greens that blend in generally*

Can you find a butterfly that has different colors on top of its wings and on the bottom of its wings? If so, what is it called? Why do you think this is a good way for the butterfly to survive in its environment?

*Answers will vary. Some species have bright colors on the top sides of their wings, while the undersides have camouflage colors. This enables them to attract/communicate with other butterflies when flying, and to blend in and hide from predators when they are resting with their wings folded together. Some examples are the Morpho and Indian Deadleaf butterflies.*

Can you find any other organisms at the Academy that are camouflaged with their environment?

*Answers will vary. Many examples can be found in the African, Asian, and North American Diorama Halls.*

**Chemical Defenses**

Can you find any butterflies with bright warning colors? If so, what colors do you see? What do you think the butterfly is warning against?

*Answers will vary. Colors may include bright red, orange, yellow, green, etc. The butterfly is trying to warn predators that it is poisonous and unpalatable.*



## Rubric 11.3 for Student Handout 11.3

## Adaptations/Defenses

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	2 – Approaching Standards	1 – Below Standards	Score
<b><u>Answers</u></b>	All of the answers are clearly supported with specific examples that are relevant to the question.	Most of the answers are clearly supported with specific examples that are relevant to the question.	At least two of the answers are clearly supported with specific examples that are relevant to the question.	Answers are not clearly supported with specific examples and/or are not relevant to the question.	
<b><u>Accuracy</u></b>	All supportive facts are reported accurately.	Almost all supportive facts are reported accurately.	Most supportive facts are reported accurately.	Most supportive facts are inaccurately reported.	
<b><u>Sentence Structure</u></b>	All sentences are well-constructed with varied structure.	Most sentences are well-constructed and there is some varied sentence structure in the essay.	Most sentences are well constructed, but there is no variation in structure.	Most sentences are not well-constructed or varied.	
<b><u>Grammar &amp; Spelling</u></b>	Author makes no errors in grammar or spelling that distract the reader from the content.	Author makes 1-2 errors in grammar or spelling that distract the reader from the content.	Author makes 3-4 errors in grammar or spelling that distract the reader from the content.	Author makes more than 4 errors in grammar or spelling that distract the reader from the content.	

## Rubric 11.R for Reflection Paragraph

## Adaptations/Defenses

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	2 – Approaching Standards	1 – Below Standards	Score
<b><u>Focus or Thesis Statement</u></b>	The thesis statement names the topic of the paragraph and outlines the main points to be discussed.	The thesis statement names the topic of the paragraph.	The thesis statement outlines some or all of the main points to be discussed but does not name the topic.	The thesis statement does not name the topic AND does not preview what will be discussed.	
<b><u>Accuracy</u></b>	All supportive facts are reported accurately.	Almost all supportive facts are reported accurately.	Most supportive facts are reported accurately.	Most supportive facts are inaccurately reported.	
<b><u>Sentence Structure</u></b>	All sentences are well-constructed with varied structure.	Most sentences are well-constructed and there is some varied sentence structure.	Most sentences are well constructed, but there is no variation in structure.	Most sentences are not well-constructed or varied.	
<b><u>Grammar &amp; Spelling</u></b>	Author makes no errors in grammar or spelling that distract the reader from the content.	Author makes 1-2 errors in grammar or spelling that distract the reader from the content.	Author makes 3-4 errors in grammar or spelling that distract the reader from the content.	Author makes more than 4 errors in grammar or spelling that distract the reader from the content.	

**Target:** 5-8<sup>th</sup> Grade

**Duration:** One 45-minute lesson w/extension options and parent links

**Discipline Connections:** Science, Math, English, Visual Arts, Technology

**Before Lesson/Materials:** Copies of Student Handouts 11.2, 12.1, 12.2, and Rubrics 12.2 and 12.R for each student

**Word Bank:** Adaptation, Defense, Predator, Parasite, Mimicry, Camouflage, Deception, Eyespot, Warning Coloration

**Objective:** Students will demonstrate their abilities to identify some predators of butterflies and the defenses that butterflies use to avoid getting eaten.

**Background:** In this lesson, students will co-write stories that incorporate facts about predators and defense mechanisms.

**Focusing Question:** Pretend that you are a butterfly and a bird is chasing you. The bird wants to eat you. Explain what you would do. Next, write from the perspective of the bird and explain why you would like to catch and eat the butterfly.

**Procedure:**

1. Have students respond in writing to the focusing question. Select a few students to share highlights from their responses.
2. Explain that students will be creating partner stories written from the perspective of a butterfly or predator.
3. State the lesson's objective and write the objective on the board.
4. Pass out Student Handouts 11.2 and 12.1.
5. Pair students up and have them read the handouts aloud to each other. One student should read the handout about predators as the other student listens, and then the roles of listener and reader should be switched as the second handout is read.
6. Explain that students should decide within their pairings who will be the predator or the butterfly in their story. After student pairs make their selections, handout the partner story directions on Student Handout 12.2, as well as Rubric 12.2.
7. Read the directions and answer student questions as necessary.
8. Allow time for students to perform necessary research and to develop their stories.
9. Students may need additional class time to illustrate and finish their books.

**Reflection:** Have students write down three new things that they learned, two questions that they still have, and one thing that surprised them. Share out some sample student responses. Distribute Rubric 12.R.

**Assessment:** Completed Partner Story Book, 3-2-1 Reflection response

### **Extension Options:**

- Have students conduct research and create a flow chart of several predators and their prey to demonstrate the properties of a food chain.
- Have students use the books that they created to teach students from other classes about butterflies and their predators.
- Have students create artwork that demonstrates their understanding of mimicry.

### **Parent-Links:**

- Join the Young Entomologists' Society located at:  
6907 West Grand River Ave.  
Lansing MI 48906-9158  
Phone/fax: 517-886-0630  
E-mail: [YESbugs@aol.com](mailto:YESbugs@aol.com)  
On the web at: <http://members.aol.com/yesbugs/mainmenu.html>
- Design a chart with several columns showing various butterflies and the creature(s) that they mimic or which mimic(s) them.
- Check books out from the library about butterflies and their predators. Read together each night.

### **Resources:**

- <http://www.enchantedlearning.com/subjects/butterfly/allabout/Defense.shtml>
- <http://home.cogeco.ca/~lunker/mimicry.htm>
- <http://www.enchantedlearning.com/subjects/butterfly/allabout/Defense.shtml>
- <http://www.readwritethink.org/materials/bookcover/planningsheets.html>
- <http://www.readwritethink.org/materials/comic/index.html>
- <http://www.makingbooks.com/accordion.html>
- <http://www.makingbooks.com/hotdog.html>
- <http://members.aol.com/yesbugs/mainmenu.html>

### **Standards:**

***Philadelphia City Standards:*** Reading 1, 2, 3; Writing 1, 2, 3; Speaking 1, Listening 1; Science 1, 4, 5; Math 6; Art 1, 4, 7

***Pennsylvania State Standards:*** Reading, Writing, Speaking, Listening 1.1, 1.2, 1.4, 1.5, 1.6, 1.8; Science and Technology 3.3.A and B, 3.6B, 3.7C and E; Family and Consumer Sciences 11.2H; Math 2.4, 2.5; Art 9.1B, I, J, and K; Environment and Ecology 4.5A, 4.7B

# Caterpillar and Butterfly Defense Mechanisms

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<http://www.enchantedlearning.com/subjects/butterfly/allabout/Defense.shtml>

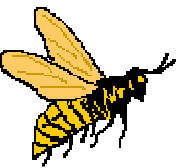
## Caterpillars



Caterpillars are soft bodied and slow moving. This makes them easy prey for predators, like birds, wasps, and mammals to mention just a few. Some caterpillars are even eaten by their fellow caterpillars (like Zebra swallowtail larva which are cannibalistic).

In order to protect themselves from predators, caterpillars use different strategies, including:

- **Poison** Some caterpillars are poisonous to predators. These caterpillars get their toxicity from the plants they eat. Generally, the brightly colored larvae are poisonous; their color is a reminder to predators about their toxicity. Some poisonous caterpillars include the Monarch and the Pipevine Swallowtail.
- **Camouflage** Some caterpillars blend into their surroundings extraordinarily well. Many are a shade of green that matches their host plant. Others look inedible objects, like bird droppings (the young Tiger Swallowtail larva).
- **Eyespots** Some caterpillars have eyespots that make them look like a bigger, more dangerous animal, like a snake. An eye spot is a circular, eye-like marking found on the body of some caterpillars. These eyespots make the insect look like the face of a much larger animal and may scare away some predators.
- **Hiding** Some caterpillars encase themselves in a folded leaf or other hiding place.
- **Bad smells** Some caterpillars can emit very bad smells to ward off predators. They have an osmeterium, an orange, y-shaped gland on their neck which gives off a strong, unpleasant odor when the caterpillar is threatened. This keeps away dangerous wasps and flies that try to lay eggs in the caterpillar; these eggs would eventually kill the caterpillar as they hatch inside its body and eat its tissues. Many swallowtails have an osmeterium, including the Zebra Swallowtail.



## Butterflies

Butterflies are fragile and almost defenseless creatures. They rely on a variety of strategies to protect them from hungry predators. Their predators include birds, spiders, reptiles, other invertebrates (e.g., wasps, flies, and mites), and small mammals.

**CAMOUFLAGE**

Most butterflies and moths protect themselves from predators by using camouflage. Some butterflies and moths blend into their environment so well that it is almost impossible to spot them when they are resting on a branch. Some butterflies look like dead leaves (like the Indian Leaf butterfly), others look like the bark of a tree (e.g., the Carpenter Moth).

**POISON**

Some butterflies are poisonous. When a predator, like a bird, eats one of these butterflies it becomes sick, vomits violently, and quickly learns not to eat this type of butterfly. The sacrifice of one butterfly will save the lives of many of its kind (and other species that look like it - see the section on mimicry below).

Many poisonous species have similar markings (warning patterns). When a predator learns this pattern (after becoming sick from eating one species), many species with similar patterns will be avoided in the future.

Some poisonous butterflies include the Monarch (which eats the milkweed plant to become poisonous), the Small Postman butterfly, and the Pipevine Swallowtail.

**MIMICRY**

Mimicry is when two unrelated species have similar markings.

**Batesian mimicry** is when a non-poisonous species has markings similar to a poisonous species and gains protection from this similarity. Since many predators have become sick from eating the poisonous butterfly, they will avoid any similar looking animals in the future, and the mimic is protected.

**Müllerian mimicry** is when two poisonous species have similar markings; fewer insects need to be sacrificed in order to teach the predators not to eat these unpalatable animals. Tropical Queens and [Monarch butterflies](#) are two poisonous butterflies that have similar markings. Another example is the poisonous Viceroy which mimics the poisonous [Monarch butterfly](#).

**FLYING**

Flying is one of the main defenses of butterflies. The speed varies among butterfly species (the poisonous varieties are slower than non-poisonous varieties). The fastest butterflies (some skippers) can fly at about 30 mile per hour or faster. Slower butterflies fly about 5 mph.



The Goliath Birdwing is a poisonous butterfly from Indonesia. Its bright colors remind any experienced predators (those who ate one in the past and became sick) that it tastes very bad.

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**Word Bank:** Unpalatable- unpleasing to taste

### **Predators and Parasites of Caterpillars and Butterflies**

Butterflies face many dangers throughout their life cycles, both natural and man-made. Although an adult butterfly may lay hundreds or even thousands of eggs in its lifetime, only around 1-2% of these eggs will usually survive long enough to become adults themselves! Natural threats to butterflies include weather, accidents, disease, and other animals.

Animals threaten butterflies either as predators or parasites. Predators will eat butterflies at all stages of their lives – as eggs, caterpillars, pupae, or adults. Predators include birds (such as jays, crows, starlings, and robins), small mammals (such as bats, foxes, monkeys, skunks, moles, and mice), reptiles (such as lizards and turtles), and amphibians (such as toads and frogs). Invertebrates will eat butterflies, too, including spiders, scorpions, and other insects like dragonflies, ants, or praying mantises. Even caterpillars sometimes eat other caterpillars! Some people in different parts of the world also eat caterpillars because they contain protein and fat.

Other animals are parasites on adult butterflies (like mites) or on caterpillars (like wasps or small flies). They lay their eggs inside or on their hosts (the butterflies or caterpillars). Other parasites lay their eggs on leaves, which caterpillars swallow when eating. The eggs hatch inside the caterpillar's or butterfly's body. As they grow, the larvae of the parasites feed on the organs of the host, gradually killing the creature. Wasps sometimes emerge from a butterfly's pupa instead of a butterfly as a result of this process.

A single caterpillar may be infested with thousands of parasitic animals. Sometimes, more than one species of parasite can live in the same host body. Parasites do not always kill a host, but they usually at least make the animal sick. Bacteria, fungi, and viruses also make caterpillars and butterflies sick, by causing illness or disease. Farmers sometimes use specific parasites or diseases to protect their crops from hungry caterpillars, so that they don't have to use poisonous pesticides.

### Partner Story Directions

**GOAL:** You and your partner are going to write a story from the perspectives of a butterfly and a predator. You will co-write the story and create illustrations for each page. Finally, you will use a book-making strategy to display your best draft.

1. Decide between yourselves who is going to be the butterfly and who the predator.
2. Choose what kind of butterfly and which predator you are going to be. It is extremely important that you select a specific species of butterfly because different butterflies use different defense mechanisms.
3. Re-read the part of your handout that relates to your chosen role and underline important facts.
4. It may be necessary to conduct some additional research to find out more about your species of butterfly or your chosen predator.
5. Create a list of facts that you will use when you write your story.
6. Talk with your partner and decide what type of story you want to write (select a *genre*). Do you want to write a science fiction, fiction, or nonfiction story? Or would you rather write a play, an epic poem, a comic strip, etc.?
7. Decide if the predator will eventually catch and kill the butterfly or if something else will happen.
8. Write down your ideas for a beginning, middle, and end.
9. Start to write your story together.
10. Be sure to include everything from the checklist below and preview the story rubric so that you understand how you will be graded.

#### Partner Story Checklist

- \_\_\_ 4 facts about the butterfly
- \_\_\_ 4 facts about the predator
- \_\_\_ genre selection
- \_\_\_ beginning, middle, end
- \_\_\_ illustrations or diagrams
- \_\_\_ first draft w/revisions
- \_\_\_ select a book making strategy to showcase your best draft

#### Book Making Resources

Book Cover Design <http://www.readwritethink.org/materials/bookcover/planningsheets.html>

Create a Comic Book

<http://www.readwritethink.org/materials/comic/index.html>

Accordion Books

<http://www.makingbooks.com/accordion.html>

Hot Dog Booklets

<http://www.makingbooks.com/hotdog.html>

[insert Rubric 12.3 here](#)



**Rubric 12.2 for Student Handout 12.2/Story Book**

**Adaptations/Defenses**

Student Name: \_\_\_\_\_

CATEGORY	4 – Above Standards	3 – Meets Standards	2 – Approaching Standards	1 – Below Standards	Score
<b><u>Accuracy of Facts</u></b>	All facts presented in the story are accurate.	Almost all facts presented in the story are accurate.	Most facts presented in the story are accurate (at least 70%).	There are several factual errors in the story.	
<b><u>Solution/Resolution</u></b>	The solution to the character's problem is easy to understand, and is logical. There are no loose ends.	The solution to the character's problem is easy to understand, and is somewhat logical.	The solution to the character's problem is a little hard to understand.	No solution is attempted or it is impossible to understand.	
<b><u>Creativity</u></b>	The story contains many creative details and/or descriptions that contribute to the reader's enjoyment. The author has really used his imagination.	The story contains a few creative details and/or descriptions that contribute to the reader's enjoyment. The author has used his imagination.	The story contains a few creative details and/or descriptions, but they distract from the story. The author has tried to use his imagination.	There is little evidence of creativity in the story. The author does not seem to have used much imagination.	
<b><u>Writing Process</u></b>	Student devotes a lot of time and effort to the writing process (prewriting, drafting, reviewing, and editing). Works hard to make the story wonderful.	Student devotes sufficient time and effort to the writing process (prewriting, drafting, reviewing, and editing). Works and gets the job done.	Student devotes some time and effort to the writing process but was not very thorough. Does enough to get by.	Student devotes little time and effort to the writing process. Doesn't seem to care.	

## Rubric 12.R for 3-2-1 Reflection Response

## Adaptations/Defenses

Student Name: \_\_\_\_\_

CATEGORY	4	3	2	1	Score
<b><u>3-2-1 Components</u></b>	Detailed response is neatly presented and includes all required information.	Response includes all required information and is legible.	Response includes most required information and is legible.	Response is missing required information and is difficult to read.	
<b><u>Notes</u></b>	3-2-1 components are recorded and organized in an extremely neat and orderly fashion.	3-2-1 components are recorded legibly and are somewhat organized.	Notes are recorded.	Notes are recorded only with peer/teacher assistance and reminders.	
<b><u>Mechanics</u></b>	No grammatical, spelling, or punctuation errors.	Almost no grammatical, spelling, or punctuation errors.	A few grammatical, spelling, or punctuation errors.	Many grammatical, spelling, or punctuation errors.	
<b><u>Amount of Information</u></b>	All 3-2-1 components are addressed, and all questions answered with at least 2 sentences about each.	All 3-2-1 components are addressed, and most questions answered with at least 2 sentences about each.	All 3-2-1 components are addressed, and most questions answered with 1 sentence about each.	One or more 3-2-1 components were not addressed.	

# Glossary

Abiotic – non-living; applied to the physical and chemical components of an environment (air, water, sunlight, soil, etc.)

Adaptation – a physical or behavioral trait which helps an organism to survive and reproduce in its environment

Adult – a living organism that has attained full growth or maturity; in insects, the last stage in the life cycle

Advocacy – the active support of a cause, idea, policy, or proposal

Amphibian – a cold-blooded, vertebrate animal typically having gilled, aquatic juveniles and adults that breathe air and live at least partly on land

Antennae (pronounced an-TEN-ee, *s. antenna*) – one of a pair of flexible, segmented, sensory appendages on the head of insects or other arthropods

Arthropod – a phylum of invertebrates characterized by an exoskeleton made of chitin, a segmented body, and paired, jointed appendages; includes insects, crustaceans, arachnids, etc.

Biotic – living components of the environment (plants, animals, etc.)

Butterfly – a general name for a diurnal species of Lepidoptera; specifically, the adult stage of the life cycle of a butterfly, the form that is winged and reproductively-mature

Camouflage – the concealment or disguise of an organism through the use of colors or patterns that make it appear to be part of its surroundings

Caterpillar – the larva of a butterfly or moth

Chemoreceptor – a sensory nerve cell or organ, as of smell or taste, that detects and responds to chemical stimuli

Chrysalis – the pupa of a butterfly

Climate – the average weather conditions (including temperature, precipitation, wind, etc.) in a particular location over an extended period of time

Cocoon – a case woven by some moth caterpillars to protect the pupa, made from silk secreted by the larva and sometimes with leaves or soil

Communication – the transfer of information between individuals by way of chemical, physical, or electrical signals or behavior

Complete Metamorphosis – a developmental process, such as that undergone by butterflies, characterized by four distinct life stages: egg, larva, pupa, and adult

Compound Eye – a multifaceted eye present in many insects and crustaceans that consists of up to several thousand units (each with its own lens)

Conservation – the protection, preservation, management, or restoration of wildlife and other natural resources

Cycle – a periodically repeated sequence of events

Deception – the act of deceiving or giving a false appearance

Defense – a means or method of protecting oneself

Diapause – a period of dormancy in certain insects, typically in response to adverse environmental conditions (such as winter or drought), during which growth or development is suspended

Diurnal – active during the daytime

Dormancy – a state of inactivity or rest

Egg – the reproductive body of various animals, consisting of an embryo (if fertilized) or just a female sex cell (if unfertilized) surrounded by a shell or protective covering; in insects, the first stage in the life cycle, from which the larva hatches

Endangered Species – a species that is few in numbers and faces imminent extinction

Exoskeleton – the rigid, external supportive covering in insects and other arthropods, made of chitin

Extinct Species – a species that has died off and no longer exists

Eyespot – a rounded eyelike marking, usually a spot of color inside a ring of another color

Form – the shape and structure of an organism or object

Function – the physiological activity of an organ or body part, or the purpose for which something exists

Habitat – the physical place where a plant or animal lives and obtains its needs for survival

Hibernation – a dormant or inactive state in which some animals spend the winter, characterized by a slowing of metabolism

Host Plants – species-specific plants on which caterpillars feed and on which adult butterflies lay their eggs

Insect – a typically small, arthropod animal having an adult stage characterized by three pairs of jointed legs, a body segmented into head, thorax, and abdomen, two antennae, compound eyes, and (usually) wings

Incomplete Metamorphosis – a developmental process in certain insects characterized by three stages: egg, larva or nymph, and adult. Nymphs usually eat and live in the same way as and look similar to the adults, just smaller and without wings

Larva (*pl. larvae*, pronounced LAR-vee) – the immature, often worm-like, form of insects and other animals which hatches from the egg; the second stage in the insect life cycle

Lepidoptera – an order of insects, comprising butterflies, skippers, and moths, characterized by four broad wings covered with minute overlapping scales

Life Cycle – the characteristic course of developmental changes through which an organism passes from its inception as a fertilized zygote to its mature, reproductive state

Mandibles – the first pair of mouth parts in insects, forming the biting jaws

Maxillae (pronounced mak-SILL-ee, *s. maxilla*) – one of the first or second pair of mouth parts just behind the mandibles in insects

Metamorphosis – a developmental process involving an abrupt change in form or structure during an organism's life cycle

Migration – the periodic (often seasonal) passage of groups of animals from one region to another for feeding or breeding

Mimicry – the resemblance of one organism to another or to an object in its surroundings for concealment and protection from predators

Molting – periodic shedding of the outer covering (such as feathers or an exoskeleton), which is then replaced

Nectar – a sweet liquid that is produced by flowers of various plants

Nectar Plants – the plants from which adult butterflies drink

Nocturnal – active at night

Nymph – the larva (immature stage) of insects with incomplete metamorphosis

Ocelli (pronounced oh-SELL-eye, *s. ocellus*) – small simple eyes, usually consisting of a few light-sensitive cells and a single lens, found in many invertebrates

Overwinter – to pass the winter, often in a dormant state

Ovipositor – the external structure used by female insects to lay eggs

Palp – a segmented appendage found near the mouth in various arthropods, used for sensing and feeding

Pheromone – a chemical secreted by insects that influences the behavior or development of others in the same species, often functioning to attract the opposite sex

Photoreceptor – a sensory nerve cell or organ that detects and responds to light

Pollination – a reproductive process in plants in which pollen is transferred from the anther (male part) of a flower to the stigma (female part)

Predator – an organism that catches and kills another organism for food

Prey – an organism that is eaten or hunted by another organism

Proboscis (pronounced pro-BAHS-kis) – the slender, tubular feeding and sucking organ of adult butterflies, usually coiled beneath the head when not in use

Puddling – a behavior in which male butterflies gather around sources of minerals such as muddy soil or wet sand to drink

Pupa (*pl. pupae*, pronounced PYOO-pee) – the third stage of the life cycle in insects with complete metamorphosis, a non-feeding and non-mobile stage during which the larva transforms into the adult

Range – the geographic region in which an organism normally lives or occurs

Reproduction – the process by which an organism produces offspring

Sense – to perceive the external world through specialized organs that receive or respond to particular stimuli

Sense Receptor – a cell or organ with specialized nerves that respond to a particular stimulus (like light, scent, or sound)

Setae (pronounced SEE-tee, *s. seta*) – sensory bristle-like parts, or hairs, on insects

Species – a group of organisms that share a characteristic set of features and appearance and which can successfully breed with one another under natural conditions

Symbiotic Relationship – a close, prolonged association between members of two different species that is beneficial to one or both

Tactile – relating to the sense of touch, or used for feeling

Tarsus (*pl. tarsi*, pronounced TAR-sigh) – the segmented foot (that is, the end parts of the leg) of an insect

Threatened Species – a species that may become endangered in the foreseeable future

Warning Coloration – bright or conspicuous coloration or patterns serving to warn predators that an organism is potentially dangerous

# Standard Descriptors

## School District of Philadelphia Curriculum Frameworks Grid

### English Language Arts

- **Reading #1**- Apply effective reading strategies to comprehend, organize, analyze, synthesize, and evaluate texts to construct meaning.
- **Reading #2**- Read a variety of materials including fiction and non –fiction, classic and contemporary texts from a diversity of cultures, communication systems, and functional texts.
- **Reading #3**- Read for a variety of purposes: to seek information; to apply knowledge; to enhance enjoyment; to engage in inquiry and research; to expand world views; to understand individuality, shared humanity, and the heritage of the people in our city as well as the contributions of a diversity of groups to American culture and other cultures around the world.
- **Writing #1**- Plan, draft, revise, and publish writing using correct grammar, sentence structure, punctuation, spelling, and effective vocabulary, appropriate to the purpose, context, and audience
- **Writing #2**-Write for academic, personal, social, civic, and school-to-career purposes.
- **Writing #3**-Write in a variety of forms including journals, essays, stories, letters, plays, poems, and reports using figurative, descriptive, literary, and technical language.
- **Speaking #1**- Speak for a variety of purposes including informing, persuading, questioning, problem solving, sharing ideas and stories, reaching consensus, and responding sensitively and respectfully using language appropriate to the context, audience, and purpose.
- **Listening #1**- Listen actively for a variety of purposes including comprehending, interpreting, analyzing, evaluating, responding effectively, and for enjoyment.
- **Listening #2**- Recognize the diversity of oral English language use, patterns, and dialects, and understand its implications across social contexts, cultures, ethnic groups, and geography.

### Social Studies

- **Social Studies #1** – *Culture* Demonstrate an understanding of culture and how culture affects the individual and society.
- **Social Studies #2** *Time, Continuity, and Change* - Analyze historical events, conditions, trends and issues to understand the way human beings view themselves, their institutions, and others, now and over time, to enable them to make informed choices and decisions.
- **Social Studies #3** *People, Places, and Environment* - Apply geographic skills and knowledge to demonstrate an understanding of how geography affects people, places, movement, and environments.
- **Social Studies #4**: *Individuals, Groups and Institutions* - Demonstrate an understanding of the role of individuals, groups, and institutions and how their actions and interactions exert powerful influences on society.
- **Social Studies #5**: *Power, Authority, and Governance* - Understand and communicate the ideas and mechanisms developed to meet the needs of citizens, manage conflict, and connect individuals and groups in the process of change.

- **Social Studies #6:** *Production, Distribution, and Consumption* - Analyze and relate how human and natural resources are organized for the production, distribution and consumption of goods and services.

## **Science**

- **Science #1** *Nature of Science* - Understand the nature of science through observing, thinking, experimenting, and validating. (This is a cross-cutting standard and it is to be infused into all content standards #2, #3, #4 levels 1 and 2.)
- **Science #2** *Physical Setting* - Have a basic knowledge of the overall structure of the universe, the physical principles on which it runs, and the processes that shape the earth.
- **Science #3** *Living Environment* - Develop an understanding of the characteristics and life cycles of organisms and their environments.
- **Science #4** *Human Organism* - Know and understand human body functions, the factors that influence its structures and functions, and how these structures and functions compare with those of other animals.
- **Science #5** *Designed World* - Understand the interrelationship of science and technology and the function of technological design.
- **Science #6** *Bridges To Math and Technology* - Understand that science, mathematics, and technology are dependent upon and reinforce each other, promoting new and high levels of understanding, discovery, and problem solving.
- **Science #7** *Historical Perspectives* - Understand & explain the interrelationship between scientific investigation & discovery, the events of world history, & the contributions of diverse cultures - e.g., especially African, Asian/Pacific, European, Latino, and Native American cultures.

## **Mathematics**

- **Math #1** *Number Systems* - Arithmetic, Relationships, and Theory - Develop the ability to represent numbers verbally, concretely, and symbolically in order to operate with numbers and symbols, recognize relative magnitude of numbers, construct number meanings, estimate reasonableness of answers, and apply knowledge and understanding of these concepts in problem solving situations.
- **Math #2** *Measurement* - Solve problems in which there is a need to measure accurately by selecting and using appropriate tools, techniques, and units; apply the results and communicate the reasoning used in solving these problems.
- **Math #3** *Geometry* - Understand space and dimensionality concepts; use them appropriately and accurately and communicate the results clearly.
- **Math #4** *Patterns, Algebra, and Functions* - Use algebraic methods to explore, model, and describe patterns and functions involving numbers, shapes, data, and graphs in problem solving situations and communicate the reasoning used in solving these problems.
- **Math #5** *Using Data, Statistics, and Probability* - Solve problems by interpreting data and predicting outcomes; make decisions based on the information collected, and clearly communicate the reasoning used to obtain the results.
- **Math #6** *Problem Solving and Reasoning* - Develop the abilities to formulate problems, implement various strategies to find solutions, draw logical conclusions, and clearly communicate procedures and results of the investigation.



- **Math #7** *Applications and Connections* - Incorporate the fundamental elements of mathematics and integrate mathematics with all disciplines while relating the results to the everyday world.
- **Math #8** *Communication* - The process standards are embedded in all student work and assessments in mathematics.
- **Math #9** *Use of Tools and Technology* - Solve and communicate conclusions to problems by using the appropriate tools and technology to collect, organize, and record data.

### **Visual Arts**

- **Arts #1** *Media, Technique, Processes* - Understand and apply art media, techniques, and processes.
- **Arts #2** *Elements, Principles, Features* - Demonstrate knowledge of elements, principles, and expressive features from diverse historical periods and cultures, especially African, Asian/Pacific, European, Latino, and Native American cultures.
- **Arts #3** *Subject Matter, Symbols, Ideas* - Recognize, select, and evaluate a variety of subject matter, symbols, and ideas from diverse cultures and historical periods, especially African, Asian/Pacific, European, Latino, and Native American cultures, in making original works of art.
- **Arts #4** *Reflecting on Artwork* - Observe, reflect, and value the characteristics, meanings, uses, and merits of one's own artwork and artwork from diverse cultural groups and historical periods.
- **Arts #5** *Historical, Social, Cultural* - Understand the visual arts and artifacts in relation to historical, social, and cultural contexts, especially African, Asian/Pacific, European, Latino, and Native American cultures.
- **Arts #6** *Racial, Cultural Gender* - Use the visual arts and artifacts as a way of understanding ourselves and our communities through racial, cultural, and gender differences and similarities.
- **Arts #7** *Relationship with Other Arts* - Understand the interconnection between the visual arts and all disciplines.

### **Pennsylvania Academic Standards**

The complete list of Pennsylvania state standards for each content area can be accessed at: [http://www.pde.state.pa.us/stateboard\\_ed/cwp/view.asp?a=3&Q=76716&stateboard\\_edNav=154671&pde\\_internetNav=](http://www.pde.state.pa.us/stateboard_ed/cwp/view.asp?a=3&Q=76716&stateboard_edNav=154671&pde_internetNav=)