INSECT SURVIVAL
Lesson Plan

TARGET AUDIENCE
Third through Sixth grade

STANDARDS
VA grades 3-5: Scientific investigation; Life processes; Living systems.
MD grades 3-5: Applying evidence and reasoning; Life science; and Evolution
DC grades 3-4: Scientific thinking and inquiry and Life science

* See page 3-4 for an in-depth list of standards of learning covered in this program.

OVERARCHING GOAL
To observe, compare, contrast and analyze characteristics that aid in insect survival.
Please note: if the objects used in the lesson include arthropods, then the lesson will be altered to include insects and other arthropods. Objects are chosen based on availability.

STUDENT OBJECTIVES
1. Students will establish insect characteristics and basic survival needs.
2. Students will observe and articulate insect characteristics.
3. Students will predict how insect characteristics aid in survival.
4. Students will compare and contrast survival characteristics to find patterns.

STUDENT OUTCOMES
1. Students will list insect characteristics and how they help with insect survival.
2. Students will look for patterns in the characteristics that help insects survive.
3. Students will demonstrate attention to survival techniques such as camouflage, mimicry, biting and stinging, flying and defense.

MATERIALS, RESOURCES, TIME, SPACE
Materials: Variety of insects. Insect Activity Sheet for Discovery Room, Arthropod Activity Sheet for Insect Zoo and Post Activity Sheet for Classroom
Time: 45 minutes in Discovery Room.
Space: Discovery Room and Insect Zoo.

 = denotes helpful suggestions

PROCEDURE

Welcome: Scientist Discussion (2 minutes):
Teachers and students are welcomed. The lesson begins with the instructor referencing a scientist in the museum who studies and collects insects: **Entomologists**. Students will be told that they will practice being Entomologists in today's lesson as they explore insects. The role of an Entomologist and important scientist skills – using their sense of 'sight' and prediction will be discussed.

Brainstorming (Focus on Students Previous Knowledge) (5minutes):
First, the instructor will ask students to close their eyes and visualize an insect they have seen. The instructor will explain that he or she needs their help in drawing what they think an insect looks like (this activity will activate prior knowledge and establish the distinguishing characteristics of insects versus other arthropods). The characteristics suggested by the students will be drawn and the docent will use follow up questions to promote further inquiry. The instructor will model effective thinking strategies for the students and promote a collective learning experience.

Brainstorming (Promote further thinking and modeling) (5minutes):
With the establishment of insect characteristics, the instructor will ask the students what they think an insect needs to survive (this activity will generate ideas and curiosity). A list of basic survival needs will be documented for students to refer back to during their small group's activity.

Helpful suggestion: If students appear stumped, you can help the students brainstorm by asking what they need as **human beings** to survive.

After brainstorming the instructor will explain that they are going to work in teams and explore five stations, each containing a different insect. First, they will look at each insect and describe what they 'see'. Then, they will 'predict' how they think an insect's characteristics help it to survive. The instructor will model an example by choosing an animal on the Biodiversity Wall. He or she will describe what they 'see' and then 'predict' how they think the part (s) (such as claws) might help the animal to survive.

Helpful suggestion: Remind students about the list of **basic survival needs** made during the introductory brainstorm. Ask students if any of the insect's **characteristics** help it with these needs: **food, water, shelter, air, protection and a place to raise their young**. How might an insect's body parts help it to get food or maybe protect it from a predator?

Centers (Exploration and Discussion in Small Groups) (20 minutes):
The students will visit five stations that include one insect each. They will be encouraged to work as a team, talk out loud and that there is often more than one right answer. First, the students will be asked to examine the insect with their eyes and describe what they 'see' (this activity will focus on observation skills). A docent or chaperone will record what the students say in order to enhance the student's flow of thinking. Second, the students will be asked how they think the insect's characteristics

help it to survive. The students should be able to back up their ideas with reasoning (this activity will focus on interpretation and predication skills).

Helpful suggestion: Always ask the student's for their ideas **first**, however, you may need to **model** effective thinking and/or problem solving. If the students seem stumped, focus their attention on the specimen. Encourage them to reflect on what they **"see"**. How might the insect's body parts and/or color help it to survive? Support students in incorporating **survival adaptations** such as **camouflage, biting, stinging, flying, fleeing, defense and mimicry** into the conversation.

Reconvene (Generate Further Thinking) (10minutes):
Using photos of the each insect, the instructor will ask students to share characteristics they observed and how they predicted the characteristics would help with survival. After ideas are documented, the students will be asked to look for patterns; to compare and contrast. How are the insects alike or different? Patterns in basic survival adaptations should be acknowledged: camouflage, biting, stinging, flying, fleeing, defense and mimicry.

If time permits, the students will then revisit their drawing from the beginning of the lesson. The students will be asked if they would like to add any new characteristics to their insect. How could they help it to survive? (This will connect prior and newly acquired knowledge)

The students will be asked to give themselves a round of applause for being such excellent Entomologists!

Closure (Thinking Post Lesson) (3 minutes):
The students will be asked to think about something they are still curious about; something they want to further explore about Insect Survival (this activity stimulates and sets the stage for further inquiry).

Helpful suggestion: The instructor can model a curious question by giving an example. "I wonder why some butterflies I see have circles on their wings. I wonder if they are used for survival?"

If the students are going to the Insect Zoo, they will be told that they are going to see many new arthropods in different habitats. They will be challenged to discover which are insects? Which are other arthropods? How are they alike or different? How do they think they use their characteristics to survive?

If the students are going home, they are also given a challenge. Next time they think they see an insect, look closely. Is it an insect? Does it have the characteristics of an insect? What does it look like and what might help it to survive?

The students and teachers will be thanked for coming, and also the chaperones for their assistance. Students are encouraged to visit again!

STANDARDS

VA Grades 3-6:

- 3.1: a) Predictions and observations are made.
  g) Data are gathered and charted in a table.
  j) Inferences are made and conclusions are drawn.
- 3.4: The student will investigate and understand that behavioral and physical adaptations allow animals to respond to life needs. Key concepts include:
  a) Methods of gathering and storing food, finding shelter, defending themselves, and rearing young.
  b) Camouflage and mimicry.
- 3.5: c) Students will investigate and understand predator and prey relationships.
- 4.1: a) distinctions are made among observations, conclusions, inferences, and predictions.
- 5.1: h) an understanding of the nature of science is developed and reinforced.
- 6.1: k) an understanding of the nature of science is developed and reinforced.

MD Grades 3-5:

- Standard 1.B.1.a) Develop explanations using knowledge possessed and evidence from observations.
  b) Offer reasons for their findings and consider reasons suggested by others.

MD Grade 4

- Standard 3.D.1: Explain that individuals of the same kind differ in their characteristics, and sometimes the differences give individuals an advantage in surviving and reproducing.
  b) Explain that the characteristics of an organism affect its ability to survive and reproduce.

DC Grades 3-5

- 3.1.3: Keep and report records of investigations and observations using tools (table).
- 3.1.4: Discuss the results of investigations and consider the explanations of others.
- 3.1.5: Demonstrate the ability to work cooperatively while respecting the ideas of others and communicating one's own conclusions about findings.
- 3.1.10: Ask, "How do you know?" in appropriate situations, and attempt reasonable answers when others ask the same question.
- 4.1.2: Explain that clear communication is an essential part of the process of scientific inquiry.
- 4.1.4: Write descriptions of investigations, using observations as support for explanations.
- 4.1.6: Identify better reasons for believing something rather than citing comments such as, "Everybody knows that," "I just know," or "Because they say," and discount such reasons when given by others.
- 5.1.3: Record observations and be able to distinguish inferences from actual observations.
- 5.9. Students will understand that adaptations in physical structure or behavior may improve an organism's chance for survival.

INSECT SURVIVAL
Background Information for the Teacher

Background Information

What is an Insect?
An insect is an air- breathing animal with a hard jointed exoskeleton. Adult insects also have a body divided into three parts; the head with one pair of antennae, the thorax which carries three pairs of legs and usually two pairs of wings, and the abdomen which contains the digestive and reproductive organs. Insects do not have internal bones – they are invertebrates.

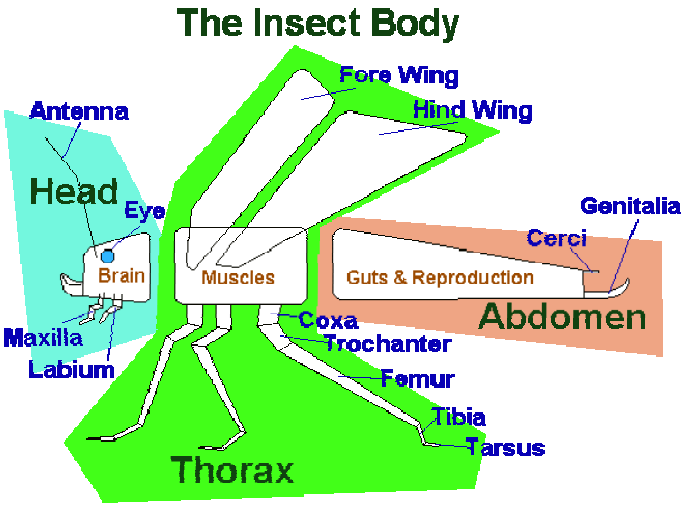


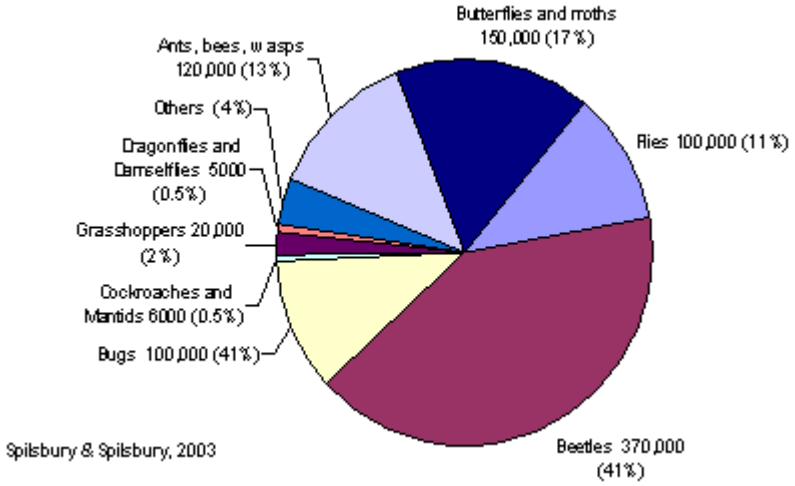
Diagram courtesy "The Wonderful World of Insects" (http://www.earthlife.net/insects/six.html; © Earth-Life Web Productions)

An insect's muscles are attached to the inside wall of the exoskeleton. The exoskeleton does not grow with an insect; over time, the exoskeleton becomes too tight for the insect's growing body and must be shed in a process is called molting. Most adult insects have two large compound eyes, made up of separate, sometimes thousands of lenses. Insects are the only animals besides birds and bats to have wings. Most adult insects have two or four wings. Their sense of smell is located in their antennae. A few insects, like ants, bees, and wasps, also have taste organs on their antennae.

Insects first appeared on earth at least 400 million years ago. Today, they live almost everywhere, from steamy tropical jungles to cold polar regions. Entomologists (scientists who study insects) estimate that the average number of insects for each square mile (2.6 square kilometers) of land equals the total number of people on the earth. Entomologists discover from 7,000 to 10,000 new species of insects each year.

Some believe there may be from 1 million to 10 million species still undiscovered! The phylum Arthropoda includes insects and other insect-like animals.

Arthropods: Number of Species by Class



Insect Survival

Arthropods have developed elaborate behaviors and adaptation strategies that have contributed to their survival. Insects have very high reproduction rates, meaning insects have a great many offspring very often. This increases the chance that the offspring will survive to adulthood. It also takes a short amount of time for insects to grow, so it therefore takes them a relatively short amount of time before the young of one brood are old enough to have offspring of their own.

Specialized Mouth Parts

Many insects have specialized ways of eating food that helps them to survive. Some have special mouthparts for chewing, such as grasshoppers. These mouthparts have mandibles, or jaws, that move sideways to allow the insect to bite and chew their food. Other insects have mouthparts that are ideal for piercing or sucking food, such as the cicada. These insects pierce their food with needle-like stylets and then suck the juice into their mouths. Some insects have sponging mouthparts, such as the housefly. These insects lap up food by way of two labella, or soft lobes. The liquid then travels through a thin tube so the animal can eat it. Another type of mouthpart used by certain insects is the chewing/lapping mouthpart. Insects such as the honeybee have such mouthparts that can be used both for biting and sucking food. Honeybees, for example, first bite into a flower and then suck the nectar up.

Camouflage and Mimicry

The ability to hide from predators who would like to eat them and the ability to hide within their habitats so that they will be able to eat, reproduce, and protect their young have contributed to insect's success in surviving. Some insects use camouflage in order to escape the notice of predators. Camouflage is a way to hide. Some insects

have bodies that are the same color as their surroundings, for example, so they blend in with their environment. Other insects mimic, or imitate, other animals. Mimicry is an adaptation in which an animal is protected from a predator due to its likeness to another, unpleasant animal. Insects may be brightly colored so that other animals can see them and know they are dangerous or poisonous and will avoid them. The Ash Borer moth is brightly colored like a wasp, although it is not capable of stinging as the wasp is. Since its colors look like a wasp, however, animals that have learned to avoid wasps due to their colors will likewise steer clear of the Ash Borer moth. When the mimic does not share the dangerous trait of the animal it is mimicking, it is called Batesian mimicry, named for the scientist Henry Walter Bates, who first noticed this form of mimicry. Some insects use a type of mimicry called automimicry, where one part of the body on the insect resembles another part of the body. Some caterpillars, for instance, have markings on their tails that look just like the markings on their eyes. This is useful in case a predator is attacking them, because the predator may attempt to eat the tail of the caterpillar instead of its head, which would be far less dangerous to the insect. A few examples of other unique arthropod adaptations are described below:

- Butterflies can be difficult to catch because of their loose-fitting wing scales which make them slippery to a predator
- Wasps can paralyze caterpillars with their sting
- The American spider has a ladder-like web that knocks the scales off a moth so that it sticks to the silk
- Caterpillars feed on poisonous plants which serve as a chemical protection against larger animals such as birds
- Butterflies and moths can copy the warning patterns and colors of the foul-tasting, toxic varieties (mimicry)
- To avoid being spotted by predators, many species blend into bark, leaves, flowers, and twigs (camouflage)
- Some species of caterpillars can resemble bird droppings to keep them safe (camouflage)
- Sphinx moths have eye-like spots behind the head or on the underside of the body; if suddenly touched, the caterpillar hides its real head and brings these spots into prominence so that it looks like a snake (mimicry)
- Birds will usually try to take their first lethal peck at their prey's head, having been attracted to the eyes; some butterflies have false heads on their hindwings (automimicry)

Glossary

abdomen *Noun.* The sections of an insect's body that contains the reproductive and digestive organs.
antennae *Noun.* A pair of thin whip-like structures (feelers) on the head of an insect, which it uses to touch and smell.
aphid *Noun.* Any one of a number of soft-bodied insects that suck the juice from plants. Also called a plant louse.
appendage *Noun.* A body part attached to another body part.
automimicry *Noun.* An adaptation in which an animal is protected against predators by one or more parts of its body resembles one or more other parts of its body.
brood cell *Noun.* In the nest of a bee or wasp, a mud, wax or paper cell in which the young are reared.
camouflage *Noun.* The colors, shapes or structures that enable an organism to blend with its surroundings.
caste *Noun.* In any colony of social insects, a group of insects of distinctive size, shape and/or behavior which carry out special tasks. For example, soldier castes are specialized for guarding the nest and workers, while the queen's role is to lay eggs.
chitin *Noun.* A hard material found in the exoskeleton of an insect.
crop *Noun.* A swollen chamber in the front part of the insect's gut in which it can store food.
furca *Noun.* A tail-like appendage that is pushed against the ground to spring an insect up into the air.
larva *Noun.* The creature that hatches from the egg of an insect that undergoes complete metamorphosis.
metamorphosis *Noun.* The physical development and changes of some insects from egg to adulthood.
mimicry *Noun.* An adaptation in which an animal is protected against predators by its resemblance to another, unpleasant animal.
molt *Verb.* The shedding of the skin that occurs from time to time as an insect grows to allow it to get bigger.
nymph *Noun.* The creature that hatches from the egg of an insect that undergoes incomplete metamorphosis.
ommatidia *Noun.* Tiny light-sensitive parts of a compound eye, each with a six-sided lens.
pheromone *Noun.* A special chemical produced in the body of an insect to send a specific message to other insects.
pupa *Noun.* A casing that protects an insect during metamorphosis from larva to adult.
spiracles *Noun.* Holes on the sides of the insect's body through which it breathes.
thorax *Noun.* The middle part of an insect's body, which contains the legs and wings.
tympanum *Noun.* A thin, flat membrane that vibrates when sound waves hit it.

Suggested Books:

Bailey, J. (1999). *How insects work together*. Tarrytown, New York, NY: Benchmark Books.

Duprez, M., & Appell-Mertiny, H. (1994). *Animals in disguise.* Watertown, MA: Charlesbridge.

Mound, Laurence. (2004). *Eyewitness Insect.* New York, NY: DK Children.

Sowler, S. (1992). *Amazing animal disguises*. New York, NY: Alfred A. Knopf.

Suggested Web Sites:

Smithsonian National Museum of Natural History—Department of Entomology
Bug Info http://www.si.edu/resource/faq/nmnh/buginfo/start.htm

National Museum of Natural History Virtual Tour of the O. Orkin Insect Zoo
http://www.mnh.si.edu/museum/VirtualTour/Tour/Second/InsectZoo/index.html

Entomological Society of America
http://www.entsoc.org/

Penn State Entomology Science Education Resources for Educators
http://entscied.cas.psu.edu/Resources.html

University of Illinois Extension "Let's Talk About Insects" (in English and Spanish)
http://www.urbanext.uiuc.edu/insects/

National Park Service, Insects: Masters of Survival
http://butterflywebsite.com/articles/nps/insects.htm

References

Kite, L. P. (2001). *Insect: Facts and folklore*. Brookfield, CT: Millbrook Press.

Powzyk, J. (1990). *Animal camouflage: A closer look*. New York, NY: Bradbury Press.

Preston-Mafham, K. (2002). *The secret world of butterflies and moths.* New York, NY: Raintree Steck-Vaughn Publishers.

Spilsbury, R, & Spilsbury, L. (2003). *From egg to adult: The life cycle of insects*. Chicago, IL: Heinemann.

Tesar, J. (1993). *Our living world: Insects*. Woodbridge, CT: Blackbirch Press.

INSECT SURVIVAL
Discovery Room Activity Sheet

Names:_____

Observe the insects at each station. An adult should function as the recorder. First ask the students to name what they "see" (characteristics). Follow up with asking how they think the characteristics will help it to survive. Record the student's ideas in the boxes below.

1. Insect name:	
What do you "see"? (characteristics)	How do you think the characteristics will help it to survive?
2. Insect name:	
What do you "see"? (characteristics)	How do you think the characteristics will help it to survive?

3. Insect name:	
What do you “see”? (characteristics)	How do you think the characteristics will help it to survive?
4. Insect name:	
What do you “see”? (characteristics)	How do you think the characteristics will help it to survive?
5. Insect name:	
What do you “see”? (characteristics)	How do you think the characteristics will help it to survive?

INSECT SURVIVAL

Insect Zoo Activity Sheet: Insect Field Notes

Explore the Insect Zoo and find an insect or arthropod you are curious about. Draw it in the box below:

Name: _____

Is it an insect? Why or why not? : _____

_____

Look at the insect or arthropod and describe what you "see" (characteristics):

_____

_____

_____

Look at its habitat and describe what you "see": _____

_____

_____

What characteristics do you think help it to survive? How? _____

_____

INSECT SURVIVAL

Post Activity to do in the classroom

Objectives: Students will predict and create an environment for insects based on observable characteristics and survival methods.

Time: 55 minutes (could be longer depending on complexity of environment design)

Materials: Activity sheets from Museum visit, reference books on arthropods, a variety of materials such as twigs, string, leaves, rocks, construction papers, markers (or pictures of various habitats), shoe boxes for habitats.

Post Activity Discussion (10 minutes)
Students share their findings from the Insect Zoo exhibits. Teacher lists the additional characteristics that aid in arthropod survival as each group presents their findings.

Post Activity Problem Solving/Application (25 minutes)
Introduce the "problem" students will solve. *You are a scientist at the NMNH and have been asked to work on a team with other Museum experts to create a habitat for live arthropods. You will need to think of ways to construct an environment that will facilitate keeping the arthropods alive.*

1. Use the same student groups. Assemble a variety of materials such as other insects, plants, rocks, construction papers, markers (or pictures of various habitats and insects). Students will choose from the material to create habitats designed to help the insects survive.

2. Teacher will circulate and ask questions about student habitats to guide them along the process.

Post Activity Presentation (20 minutes)
Members from each group present their habitat and explain how their exhibit demonstrates what their arthropods need to survive.