Insect and Spider Ecology

PURPOSE: Students will become familiar with insect and spider identification by practicing catch and release techniques. Appreciation for insect niches in the environment will be stressed.

OBJECTIVES:

1. Explain insect anatomy.
2. Compare insects to other arthropods.
3. Collect insects and identify them to family.
4. Understand the importance of insects in the food chain.

MATERIALS NEEDED:

Insect Guides	Spider Guides
Magnifying Glasses	Insect Family Posters
Bug Boxes	

PROCEDURE:

1.	Introduction (Amazing facts, what have you seen? define insect/spider)	10 min
2.	Collecting (technique, ID, comparisons)	35 min
3.	Transformations (metamorphosis)	10 min
4.	Collecting (different ecosystems)	35 min
5.	Conclusion (recap info, are insects good/bad?)	15 min.
6.	Journaling	15 min.

TEACHING TIPS

This is a class based on exploring and discovery. Much of the time will be spent looking at the insects that have collected. Act excited when the students find things, it rubs off! Try to collect from two different ecosystems for more variety. Keep track of where students are, and that they aren't mistreating the insects *or each other*! Most students can go on for quite a while collecting. There are many ways to teach this class. Go with their energy, as long as the OBJECTIVES are met, go with it!

Help with insect information: http://www.nysaes.cornell.edu/ent/biocontrol/info/primer.html

Introduction

Grab the class's attention by giving them the following facts. Today we'll look at a group of animals that has individuals that can:

- fly 40 mph
- live on the tongues of horseflies
- jump 100 times it's own height
- survive for a year without a head
- usually live only one year

What group are we talking about? **INSECTS!**

After hooking them with those *amazing* facts, make it relevant to them by asking what insects have they seen? What did they look like? Have them create an insect on your board by incorporating the unique features of insects. With more than one person drawing it, it keeps the focus of the students, and makes for one weird looking critter! After doing this, do the same for a spider, then compare and contrast the two.

Insect / Spider Comparison

	Insects	**Arachnids**
Body Parts	3 Head, thorax and abdomen	2 cephalothorax and abdomen
Legs	6 on thorax	8 on cephalothorax
Eyes	2 compound eyes/3 simple eyes	8 simple eyes
Antennae	1 pair	None
Wings	2 pair (most)	None

*Insects usually have 2 large compound eyes and 3 simple eyes located near the top of the head. The 3 simple eyes are known as ocelli. They sense differences between sunlight and shade.
**Most insects have 2 pair of wings. Some have one pair, some have none.

Collection

This is the heart of the class. Walk to your first collection site. As you're heading there, start pointing out insects or signs of insects (holes in leaves, tree dust, ant hills). Tell the students that they have been hired by St. Croix Environmental Center to sample the different kinds of insects and spiders that are out on the property. Explain how to use the equipment before handing it out. Make sure that they take responsibility for the equipment. There are enough boxes for pairs of students to use them, and enough magnifying glasses for each student. Also, remind them that they are collecting living beings, and that they should be treated well. Lose the boxes only when you are sure that the insect is completely inside. Capture only insects that fit into the box. Then, with too much pomp and circumstance, swear them in as official Insect Collectors.

> "I, state your name, promise to be expert Insect Collectors. To collect as many spiders and insects as possible. Not to squish them, not to pull their legs off, not to fry them with the magnifying glasses or in the box, and not to eat them!"

Pass out the equipment and let them go. You can give them some hints where to look: under rocks and leaves. Don't forget to set your boundaries. As they collect, show excitement at what they caught. If you don't know what it is, don't worry! Just admit that you don't. Its OK. And that's what the books are for anyway! But you can ask them to point out distinguishing characteristics, colors, number of wings, etc. Judge their interest level as to how long to go with the collecting. When you're done, compare and contrast what they found. How many legs? What colors are they? Why are they under rocks? What does it eat? Hopefully they found some inchworms or caterpillars too. And this can lead to *Metamorphosis.* Don't forget to release the animals where they were found.

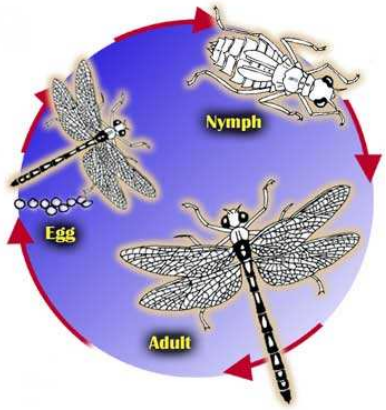
Transformations

A game that demonstrates metamorphosis via Rock, Paper, Scissors. Ask the students if a butterfly always looks the same. No? Why not? Because it changes shape. And that process is called *metamorphosis*. Explain the two paths below, and it helps to draw the various stages. And to speak like Heimlik the "beeeauutiful butterfly"

Complete Metamorphosis

Egg → Larva (caterpillar) → Pupa (cocoon) → Adult (butterfly)

Incomplete Metamorphosis



Egg → Nymph → Adult (dragonflies)

Then explain that they are now insects going through their life cycles. They all start out as eggs, then find another egg to play Rock Paper Scissors. The winner becomes a larva, and they find another

larva to challenge. This process keeps repeating until they've made it back to egg.

Second Collections: This is the same as the first but in a different ecosystem. The idea is to contrast the different critters found there. Are they the same colors? Are they the same insects? Is the food source the same? More sunlight?

Additional Activities

Six Legged Madness*.....A plan of action*: Consider this option as your field experience.

1. Gather group near insect Order boards.
2. Briefly discuss each Order, pointing out familiar insect families in each.
3. It's estimated only 2/3 of the insects of the world have been identified and named, so you may discover a new one and name it after yourself.
4. Divide classes into groups of approximately 2-3 students each.
5. Distribute collecting equipment and color-coded (or letter coded) holding jars to each small group.
6. Discuss collection techniques:
    a. Use of equipment
    b. Handling without injury...to the **insects**, that is!
7. Our goal today is to see if each group can find an insect representative for as many orders as possible. Students scatter within designated boundaries. When an insect is caught, the students return to the location of the order cards. Students read the characteristics of each order from the cards to determine in which order the correct order their captive belongs. At that time, they check the identity with the instructor. If correct, the instructor will note on the data sheet that Group A or blue (whatever) has found an insect of that particular order. Students release the insect back to where they found it and search for an insect of another order. (A minimum of two instructors should be at the order cards site to assist students in identifying their temporary captives).
8. Important notes:
    a. Put one insect in each holding jar, or your specimens may eat each other!
    b. Do not collect duplicate insects.
    c. Do not destroy habitat while collecting.
    d. Watch for poison ivy and stinging nettle. Check for any students with severe reactions to bee stings.
    e. Inform group of approximate time allotted and signal for time's up.
9. On your mark.....get set.....GO!

What have we found?

1. Discuss insects collected and check (with the help of the group) for proper placement.
2. Determine the Six Legged Madness champions and runners up.
3. Encourage questions and interactions. (There will doubtlessly be exciting stories about mishaps and near misses in collecting.)
4. It does not matter if students did not find many of the orders, just that they tried. There are no real winners or losers.

***Insect Jeopardy**:* This activity quizzes students at the end of the study session after all the material is covered. It is a perfect alternative for a rainy or a weak field day. Make sure to get the laminated poster boards from the bin.

This game can be played in one study group or combining several study groups. There are four categories: Insect Body Parts, Insect Life Cycle, Spiders vs. Insects and Insect Orders. It is a good idea to refresh yourself on the questions and answers before hand to make sure you can cover the material in class.

Divide the group into two teams. Ask 1 student from each team to come forward to answer each question. If neither "contestant" answers correctly let them confer with their teammates and answer again. For the final Jeopardy question, let the group wager and work together to answer the question. Be sure that they answer in the form of a question.

Insect Jeopardy Answers:

	Insect body parts	Insect life cycle	Insect vs. spider	Insect orders
100	*legs*	*pupa*	*legs*	*Hemiptera*
200	*mouth parts*	*larva*	*eyes*	*Coleoptera*
300	*wings*	*metamorphosis*	*spider*	*Homoptera*
400	*tongue & feet*	*incomplete metamor.*	*cephalothorax*	*Hymenoptera*
500	*thorax*	*nymph*	*antennae*	*Odonata*

***Human Knot**:* Shows the interdependency of an ecosystem. Just process it with an ecosystem theme: strength of all working together, when unraveled its a circle of energy/life, if broken will it reform? (Great for rainy days!)

All Aboard: Shows diminishing habitat and how critters may adapt behaviorally to the new circumstances. Often critters will push and shove, be left out, change behaviors etc. just like the group. (Great for rainy days if done with footprints).

***Insect Costume**:* Demonstrate visually the different parts of insects and spiders. This can be extended into a rainy day activity by having the students interview the spider and insect.

Conclusion

Have the students sit down in the mowed grass, such as on the A-field. Ask them to find as many insects as possible without getting up. In other words, right where they are sitting. Are they

finding as many different kinds? Why not? (Its only one food source, trampled, in the open, etc) Why does this area look like this? How do we affect insects and spiders?

Then ask who likes honey? oranges? Bluebirds? Would we have these if we didn't have any insects? So are insects good or bad? Why? This is where you can hit the conservation and food web thoughts. Make it relevant to the students that they affect and are affected by insects.

Journaling

Questions can be as varied as the insects and spiders that were found. Draw and label the parts of an insect and spider. List all of the insects and spiders that you caught. Create your own insect and tell what it eats, where it lives, etc. Do you think insects are good or bad? Why? How are you affected by insects? How do you affect them?

Additional Information - Spiders

In the front of a spider's mouth are jaws called *chelicerae*, made of a base and a fang. The fang stabs the bodies of prey. Near the end of the fang is a tiny opening. Venom from a poison gland flows through tubes in the *chelicerae* and out the openings to the prey.

Pedipalp are located in front of the legs by the mouth. They may look like legs but they are used to touch and taste. (During mating, sperm are transferred through the pedipalp.)

Every spider has silk glands in its abdomen. The glands produce liquid silk, which is similar to a substance found in human hair. The liquid silk is squeezed out of the body through tiny holes in finger-like appendages near the rear of the abdomen called *spinnerets* (spinning organs). As soon as the liquid silk is exposed to air, it hardens, forming a thread. The thread may only be one millionth of an inch in diameter.

Silk has many uses. It is used for building webs, wrapping up prey, protecting eggs and making nurseries for their babies. It is also their dragline, which is their safety net. As a spider crawls along, it glues its dragline to the surface every so often. When something frightens a spider, it seems to suddenly disappear. Actually, it lets go of the branch or other surface on which it was crawling, falls off and hangs from its dragline until the danger passes. Then it climbs up the dragline. When the spider is ready to return home, it retraces its steps, using the anchored dragline as is guide.

Spiders come in many sizes. The largest are the tarantulas that live in the jungles of South America. Some weigh 4 ounces and have a leg span of more than 10 inches. At the other extreme are some garden spiders that are no bigger than a pinhead.

There are about 35,000 different species of spiders that have been identified by scientists. (Tesar, 1993)

***Molting**:* Molting is when an insect grows too much to contain it's self. The exoskeleton splits down the back. The insect emerges from it's old skin and grows a new larger one. The number of molts varies from 4-40 depending on the insect species.

Taxonomy:

Phylum Arthropoda
(jointed legs, exoskeleton)

Crustacea	Insecta	Arachnida	Chilopoda	Diplopoda
(crabs)	(insect)	(spider)	(centipede)	(millipede)

Additional Information - Insects

Insects are basically cold-blooded, but by flexing wing muscles they can warm their bodies enough to fly about in cold weather. They can make antifreeze so they can withstand very cold temperatures. Insects have no lungs, no veins or capillaries and a very rudimentary heart. Blood "sloshes" inside their bodies and air diffuses to the interior cells through tiny holes located in the abdomen. If you're actually reading this, ask Barry for a Blizzard! Because they can't move oxygen through in a bigger body, insect

An insect's size is limited to about 6 inches - so much for the gigantic insect horror movies. The Greek word "entomon" means insect. Entomology is the study of insects.

None of the insects' relatives have same combination of characteristics. Spiders (arthropods) are not insects.

In addition to those mentioned above, discuss:

a. Exoskeleton - molts as it grows; made of chitin, a hard shell-like material.
b. Breathing Methods - air tubes opening to outside at holes called spiracles.
c. Circulatory System - blood pumped by heart, does not have veins. Insect blood is never red because it lacks the oxygen carrying pigment hemoglobin.
d. Hearing - eardrum (tympanic) hearing, or vibrations picked up with sensory hairs or antennae.
e. Smell - some pick up scent with antennae.
f. Taste - many taste with their feet (flies, butterflies) or antennae (bees, wasps). Still there are varying types of organs in/around the mouth of insects depending on the species.
g. Sound Production - no insect has a true voice, may make sounds by rubbing one body part against another. (Of the katydids, grasshoppers, crickets and cicadas, only the males make music)
h. Feeling- tiny hairs and spines are connected to the nervous system.

Life Cycle

All insects begin as eggs, but will go through one of three Cycles before adult stage is reached:

a. Egg - small replica of adult, grows and successively molts to size of adult

*egg ➔ young ➔ adult

Most insects change *form* during their lifetime. Metamorphosis means to change *shape*.

b. Simple (incomplete) Metamorphosis - grasshopper, dragonfly, stonefly

*egg ➔ nymph ➔ adult
*nymph has general shape of adult
*nymph splits hard exoskeleton as it grows
*wings develop externally
*no dormant stage before the final molt

c. Complex (complete) Metamorphosis - butterfly, caddisfly, ant

*egg ➔ larva ➔ pupa ➔ adult
*larva's elastic skin stretches as it grows
*pupa is the dormant stage, wrapped in protective coating
*dormant means resting but internally great changes occur
*wings develop internally
*immature and adult represent different forms and habitats

Secrets of Success

There are more insects alive at a given time than any other animal; an estimated one million for every person! Why are they so successful?

a. Reproduction ability
b. Adaptability to countless niches
c. Use of various food sources
d. Flight
e. Protective exoskeleton
f. Delayed fertilization
g. Small size

Insect Pros and Cons

INSECT PROS

1. Pollination: many flowering plants depend on insects for pollination (other pollinators are wind, bats and hummingbirds). Without insects ➔ no insect pollination ➔ fewer fruits ➔ fewer seeds ➔ fewer flowering plants ➔ less food ➔ no life as we have come to know it. Bees used for crop pollination are a $4.5 billion / year industry in USA alone.

2. Food: insects are at the base of most food chains feeding higher levels like birds, fish, frogs etc. and eventually humans.

3. Soil: insects help break down decaying material into soil and also aerate the soil.

4. Medicine and Research: used to treat diseases, provide information on heredity fruit fly studies evolution and biochemistry and used to test treatments.

5. Pollution Indicators: mayfly nymphs are the first to go in water pollution.

INSECT CONS

1. Disease: many harmful viruses are transmitted by insects; malaria and encephalitis by mosquitoes, tularemia by deer flies, bubonic plague by fleas. Rocky Mountain Spotted Fever and Lymes Disease are carried by ticks (arachnids).

2. Crop Loss: with the increase of monoculture, (single plant species dominating large acreage) insect pests have become more of a problem. About 1% of all insects are harmful to crops. Annually, about 10% of our crops are destroyed by insects.

3. Infest households: spread plant disease by scale insects. Diseases spread by flies and cockroaches.

4. Annoyance: animals, as well as people, have to receive the bites and stings of insects who make their livelihood by drinking blood. Females use the rich energy of blood to produce eggs.

Boy Scouts Merit Badge Series. 1985 Insect Life

Burnie, David. 1997 Insects and Spiders: The Nature Company Discoveries Library Time Warner Inc.

Mound, Laurence. 1993 Amazing Insects: Eyewitness Juniors Dorling Kindersly Limited, London.

Tesar, Jenny. 1993 Our Living World: Spiders Blackbirch Press Book, CT.

Zim, Herbert and Clarence Cottam. 1991 Insects: A guide to Familiar American Insects Golden Press, New York.

Vocabulary (Required Knowledge)

Arthropod - Any of numerous invertebrate animals of the phylum Arthropoda, including the insects, crustaceans, arachnids, and myriapods, that are characterized by a chitinous exoskeleton and a segmented body to which jointed appendages are articulated in pairs.

Coleoptera - An order of insects having the anterior pair of wings (elytra) hard and horny, and serving as coverings for the posterior pair, which are membranous, and folded transversely under the others when not in use. The mouth parts form two pairs of jaws (mandibles and maxill[ae]) adapted for chewing. Most of the Coleoptera are known as beetles and weevils.

Hemiptera - An order of hexapod insects having a jointed proboscis, including four sharp stylets (mandibles and maxill[ae]), for piercing. In many of the species (Heteroptera) the front wings are partially coriaceous, and different from the others.

Homoptera - A suborder of Hemiptera, in which both pairs of wings are similar in texture, and do not overlap when folded, as in the cicada.

Hymenoptera - An extensive order of insects, including the bees, ants, ichneumons, sawflies, etc.

Metamorphosis - A change in the form and often habits of an animal during normal development after the embryonic stage. Metamorphosis includes, in insects, the transformation of a maggot into an adult fly and a caterpillar into a butterfly and, in amphibians, the changing of a tadpole into a frog.

Odonata - The division of insects that includes the dragon flies.