ACTIVITIES

The following pages offer you interdisciplinary activities to help you teach your students about the wonderful world of arthropods and their importance in the environment and our lives. These activities were designed to help teachers meet the Essential Academic Learning Requirements for science and the Environmental Education Guidelines for Washington Schools. Objectives that are met by the activities are checked off on the EALR and EEG lists. Each activity is titled with recommended activities for students of different ages. Although we divided the activities with the headings of grades K-2, 3-6 and 7-12, these are rough divisions. Each class is going to vary in its abilities. Therefore, please use these divisions as a guideline but feel free to adapt the activities as you see fit for your students.

FINDING COMMON CHARACTERISTICS

There are over 1.1 million species of arthropods known today, and many scientists speculate that there are millions more still to be discovered and classified. Scientists must be familiar with identifying common characteristics in order to complete the difficult task of classifying arthropods.

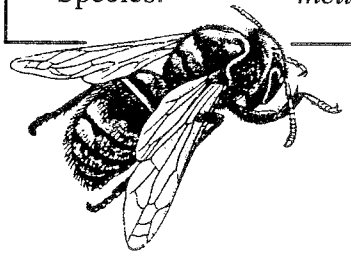
Although scientists generally use specific characteristics to classify animals, there are many ways to group objects, depending on the characteristics you choose to use.

The following are simple activities that will introduce your students to the basics of classifying objects by common characteristics.

Taxonomy

Here is an example of taxonomic classification which may be useful for several of the activities:

Honey Bee	
Kingdom:	Animalia
Phylum:	Arthropoda
Class:	Insecta
Order:	Hymenoptera
Family:	Apidea
Genus:	*Apis*
Species:	*mellifera*



Shoe Sort

Grades K-12

1. Have every student take off one of their shoes and put the shoes at the front of the room on a table where everyone can see them.
2. Now ask the students to choose two or three general characteristics by which to sort the shoes. Write down "Shoes" at the top of the black board. Below this write the categories the students chose (example: boots, sandals, sport shoes).
3. Divide the shoes into piles based on these characteristics. Now look at one pile of shoes, for example the "Sport Shoes" and ask the students to come up with two or three more characteristics by which to divide them (laces, Velcro). Write these categories below the "Sport Shoe" category and divide the sport shoes into piles based on the shared characteristics.
4. Continue dividing the shoes into smaller and more specific categories until each pile has one or just a few shoes.
5. Repeat the activity but this time have the students divide the shoes by different characteristics. Discuss which characteristics the students might consider to be more important? (e.g. color, structure, left-footed). Why?

Produce "Creatures" Nomenclature

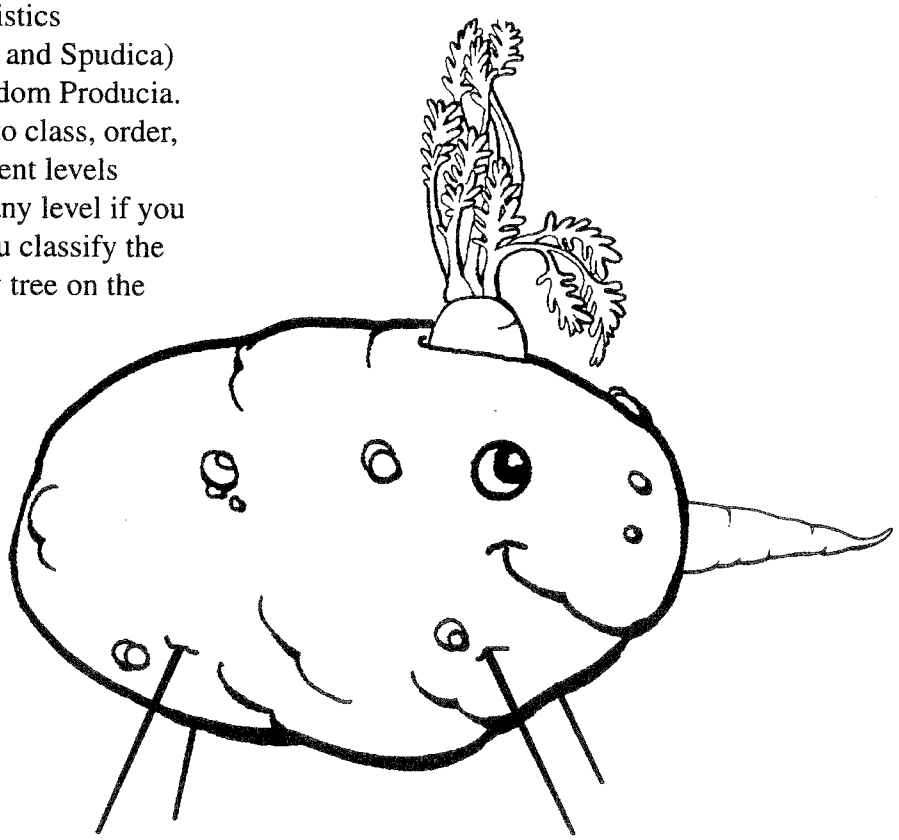
Grades 3-12

Before class make "creatures" from fruits and vegetables using markers, toothpicks, pipe cleaners, etc. Divide the students into groups of two or three students and give a "produce creature" to each group. Explain that the students are scientists who have just discovered a new kingdom of living things. They must now describe these new creatures, place them in the existing taxonomic organizational system (kingdom, phylum, class, etc.) and give them scientific names.

1. Ask each student, or group of students, to look at his/her creature and describe it on the *Produce Creature Classification Worksheet* provided. Remind your students that their description must be detailed enough that another scientist would be able to recognize another specimen from the description.

2. Now have the class place the creatures in a taxonomic structure. First, ask the class to make up a name for the entire Kingdom (example: Producia) and write it on the board. Next, have the class divide the Producia into two or three phyla based on common characteristics (example: Phylum Vegitara, Fruita and Spudica) Write these names under the Kingdom Producia. Continue dividing the creatures into class, order, family, and genus giving the different levels names as you go. You can stop at any level if you run out of creatures or time. As you classify the "produce creatures," draw a family tree on the board.

3. Once you have the creatures divided, ask the students to give their creatures genus and species names. If the class has divided the creatures down to the genus level, the genus name should be the first of the two names. The genus and species names should be Latin or "Latinized" and they should be descriptive. Both the genus and species names are italicized. The first letter of the genus is capitalized, while the species name is lower case. Use the provided list of Latin and Greek terms or a Latin dictionary to come up with names. Have the students share with their classmates the name of their produce creature and why they chose the name.



"Produce Creature" Classification

Worksheet

Physical Characteristics: _____

_____

_____

_____

_____

Scientific Name: _____

Meaning of Name: _____

Draw a diagram that you think shows the relationship between the "produce creatures" based on shared characteristics.

Latin and Greek Roots

Zoon	animal
Bios	life
Fructus	fruit
Vegitare	sluggish, inactive
Citron	lemon
Carota	carrot
Acidous	sour
Glykys	sweet
Pia	soft, delicate
Callosus	thick skinned
Sphen	wedge
Trachy	rough
Durus, Duri	hard
Fovea	pit
Urbis, Urbs	city
Vivo, Victum	live
Mikros	small
Megas	large
Magnus	large
Lipo	fat
Lepto	slender
Stereo	solid
Brachy	short
Mesos	middle
Endo	within
Exo	outside
Dormio	sleep
Sarc, Caro	flesh
Pilus, villus	hair
Gymno	bare
Sauros	lizard
Dendron	tree
Sporos	seed
Syn	together
Petros, Lithos	stone
Onoma	name
Kinesis	movement
Con	with
Nomen	name
Forma	shape
Cornu, Kerato	horn
Planus	flat
Bonus	good
Sphaira	ball or globe
Facio, Factum	make
In	not
Res	thing

Atr, negro	black
Melano	black
Brunne	brown
Rubri	red
Leuko	white
Albo	white
Virid	green
Chloro	green
Flav	yellow
Iod	purple, violet
Croco	orange
Augoranti	orange
Argo	shining
Calig	dark
Pallid	pale
Cyano	blue
Rugos	wrinkled
Unus	one
Duo	two
Tres	three
Quattuor	four
Quinque	five
Sex	six
Septuem	seven
Octo	eight
Novem	nine
Decem	ten
Centum	hundred
Mille	thousand
Stomy	mouth
Digitus	finger
Caput	head
Manus	hand
Pes, Pedis	foot
Bracchium	arm
Dens, Dentis	tooth
Corpus, Corporis	body
Oura, cauda	tail
Pteron	wing
Optic	eye
Occulus	eye, bud
Pellicula, cutice	skin
Paleo	old
Neo	new
Dameas	tame
Gravi	heavy
Trux	fierce

Observing and Describing

The art of observation is very important in science! Scientists must be good at observing the specimens they are studying. Since taxonomy, the method scientists use for classifying living organisms, is based on the ability to distinguish species through observable characteristics (e.g. body structure, DNA, behavior), taxonomists must be acutely aware of all aspects of their subjects.

Scientists have distinguished five classes within the phylum of animals called Arthropoda. There are over one million different species in just ONE of these classes, Insecta. Because of the vast numbers and smaller body sizes of most arthropods, good observation skills are vital for scientists who study and classify these animals.

The following activities will help your students develop their observation and description skills. After completing these activities, students can think about and discuss how observing and describing skills might help people other than scientists in their careers.

A: *Observation*

Grades K-12

1. Explain to your students that they are scientists studying a subject and that they must use their observation skills to learn everything they can about their subject.
2. Have your students form a circle on the floor of your room or outdoors. Select one student to stand in the middle of the circle. Allow the other students to observe this "subject" for 20 seconds. Make sure the student in the center of the circle rotates so that the other students can observe him/her from all sides.
3. Remove the "subject" from view (out of the room, behind a tree, etc.). Ask the student to change one aspect of his/her appearance, for example: untie a shoe or untuck part of their shirt. Have the student return to the center of the circle.
4. Ask the other students to observe their "subject" again. Do they notice any changes? Are their observations correct? Repeat this activity with another student as the subject. This time changing more than one aspect of appearance. Try again, but this time do not make any changes. See if the students think a change has been made.
5. Use this activity to generate a discussion about the importance of observation in science.

B: Scientific Study

Grades K-12

This exercise is designed to get students to use their observation skills and to make deductions based on their observations.

1. Place two animal or plant specimens on a table at the front of the class (if they are small objects, place a set at each table). Give the students a designated amount of time (two minutes for younger students and 10 for older students) to look at the objects and make a list of the similarities and a list of the differences between the two objects.
2. Ask the students to report their findings and record their observations in a Venn diagram on the board. Now ask them to select the two or three characteristics that they think might be the most important in determining the relationship between the specimens. Now add a third specimen and have the students compare this to the previous two. By looking at the characteristics the students decided were most important, to which of the previous two specimens do the students think the third specimen is more closely related?

C: Describing a Species

Grades 3-12

Materials: Legos, paper, pencils, cups or bags (one for each student).

This activity can be written or oral, depending on the age of your students. The number of Legos you choose to use for each team will also vary depending on the age of your students.

Preparation: Divide the students into teams of two. For each team you will need two identical sets of five different pieces of Lego. Place each set in a separate bag so neither teammate can see his/her partner's Legos.

1. Discuss with your students the importance of being able to describe a species accurately. When an organism is discovered, scientists must describe the organism in sufficient detail so that other scientists can recognize other specimens when they are found. Therefore, scientists must observe the specimen, determine which characteristics make it recognizable and be able to effectively describe the specimen to others.
2. Both members of each team of students will have an identical set of Legos. One member from each team will be asked to put his/her Legos together in a pattern and then accurately describe the Lego designs with words, (either verbally or in writing, no pictures). The second teammate from each group will use his/her partner's descriptions to put together his/her Lego set. Make sure the teammates are separated so that neither teammate can see his/her partner's Legos.

Note — Make sure that the first team member leaves her/his Lego design intact so it can be compared with his/her teammate's design at the end of the activity.

3. If you are having your students write their descriptions, you can 1) remove the second team member from the room, or 2) you can give each team two sets of Legos and have both team members create and describe a Lego structure at the same time. Allow your students 10-20 minutes to observe and describe their Lego designs. Then, turn over the written description to the teammate (do not let them see the assembled Legos) and allow the teammate an equal amount of time to assemble his/her Lego specimen.
4. If you are completing this activity orally, create a visual barrier so that neither teammate can see his/her partner's Legos. Allow each team 10-20 minutes to complete the activity.

Note — The teammate putting together the Legos can ask for directions to be repeated but the teammate giving directions should not be permitted to say whether her/his partner is correct in what she/he is doing. For this reason, visual barriers or having the partners face opposite directions would help.

Arthropod Observations

Grades K-6:
Worksheet A (can be completed with the teacher's help or on an overhead)

1. Students can use these worksheets to make observations about visual characteristics of different arthropods. If you select the arthropods for observation, you might want to try to find arthropods from different taxonomic classes, such as ants (insects), spiders (arachnids) and sowbugs (crustaceans). Or, students can collect any arthropods easily available and use the observations to determine whether they might be of the same or different classes.
2. Have students make predictions about whether the arthropods they are comparing will be of different classes. Remind students to treat the arthropods gently and return them to their natural habitat when the observation period is finished.
3. After completing the given worksheet, ask the students to observe the arthropods and determine if there are different characteristics they would use to classify the animals they are observing.

Grades 7-12:
Worksheet B, or you may choose to have older students design their own questions for study. Then ask them to develop an observation worksheet.

1. Ask your students to use magnifying glasses or a microscope to observe each of their arthropods. While they observe their subject, have them complete the *Arthropod Observations Worksheet B*, or a worksheet they designed themselves.
2. Following their observation, have each student select one of their arthropods and write a fact sheet. Fact sheets are included in this packet and can be used as examples. If they cannot determine the species they are observing, the fact sheet can be written about the family or the order from which it comes.

WHAT KIND OF BUG HAVE I FOUND?

Grades K-2
Students can complete the activity as a class.
Grades 3-12
Students can complete the activity individually.

1. Have your students find arthropods and key the animals out using the *What Kind of Bug Have I Found?* worksheet to discover what class of animal they have found. Remind your students to handle the arthropods gently and put them back where the animals were found when the students are done.

Arthropod Observations

Worksheet A

Observable Physical Characteristics	Arthropod 1:	Arthropod 2:
What does the body look like?		
Can you see any eyes or antennae on its head?		
Does it have legs? How many legs does it have?		
Does it have jointed legs?		
Does it have a hard body covering?		
Do you think it is an insect?		
What kind of animal do you think it is?		

Other observations:

Arthropod Observations

Worksheet B

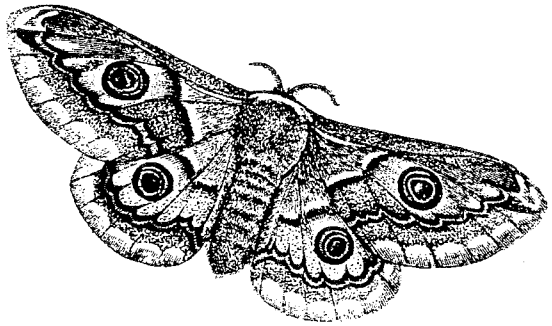
Observable Physical Characteristics	Arthropod 1:	Arthropod 2:	Arthropod 3:
What are the first three things you notice about this arthropod? Use the back of this sheet to explain the importance of each of these three characteristics.			
Describe or draw the subject you are observing.			
Are there visible sense organs in or on the head? Are there other sense organs?			
Can you detect a means of defense?			
What forms of locomotion does this animal use? How many appendages does it use to move?			
Is the body segmented?			
What class do you think this animal belongs to?			
Can you identify the species?			

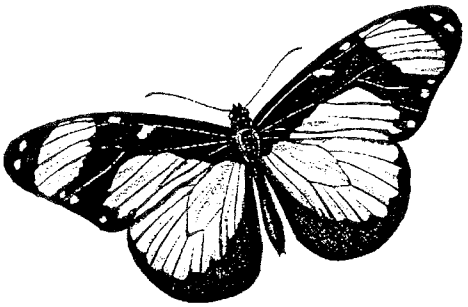
Other observations:

Comparing Moths and Butterflies

Grades K-6

1. Have your students compare characteristics of moths and butterflies. You can catch some moths and butterflies before the activity or order them through a supply company. Before you start, make sure you do some research so you can provide the insects with appropriate food, water and an adequately sized container. If you catch insects, remember to release them when the students are finished with their observations. If you purchase them, make sure they are native species before you release them!
2. Ask your students to observe the moths and butterflies for a few minutes. Tell them to look at the wings, antennae, body and so on. Now ask your students to list ways in which butterflies and moths are similar and ways they are different. Write all ideas on the blackboard or butcher paper. Discuss the students findings and point out other characteristics they may have missed and have them look again. After your discussion, have the students draw detailed pictures of a moth and a butterfly and label the characteristics of each.





Moths
fat, stocky body
feathery antennae
rest with wings flat
rest during the day/active at night

Butterflies
pinched in at the middle of their body
antennae with knobs on the end
rest with wings together over their back
rest at night/active during the day

Extension: This activity may be preceded or followed by raising butterflies in the classroom. Painted lady butterflies can be purchased from many biological supply houses. Ask the students to predict what will happen as the caterpillar grows. Have students keep a journal of the caterpillar's development into a chrysalis (KRI-sa-lis) and then an adult. Ask students to compare their predictions to the actual growth process. Point out that a four-stage life cycle (egg, larva, pupa, adult) is one of the characteristics of many insects.

Insect Suppliers:

Insect Lore
PO Box 1535
Shafter, CA 93263
1-800-LIVE BUGS
www.insectlore.com

Carolina Biological Supply
2700 York Road
Burlington, NC 27215
1-800-334-5551 x5315

DISCOVERING WILDLIFE

Bugs Appear!

Grades K-12

In this activity students will be able to observe arthropods that live in soil. Arthropods will emerge from soil that has been sitting under a lamp overnight. Ask your students why they think arthropods do this.

Materials: lamp, large-holed strainer, large bowl lined with wet paper towel, approximately two cups of soil from outside and magnifying glass.

1. Put the strainer into the large bowl. Make sure it does not touch the bottom of the bowl. Pour the soil into the strainer. Place the lamp over the bowl, about six inches away from the soil. Turn on the lamp and leave it on overnight.
2. The next day, remove the strainer and use the magnifying glasses to examine the contents of the bowl.

How many different kinds of organisms can the students see? Are the students able to identify the animals? To what taxonomic level can they identify their subjects? Ask the students to draw what the organisms look like if they can't identify them. Have your students make a chart and tally how many of each different creature they find.

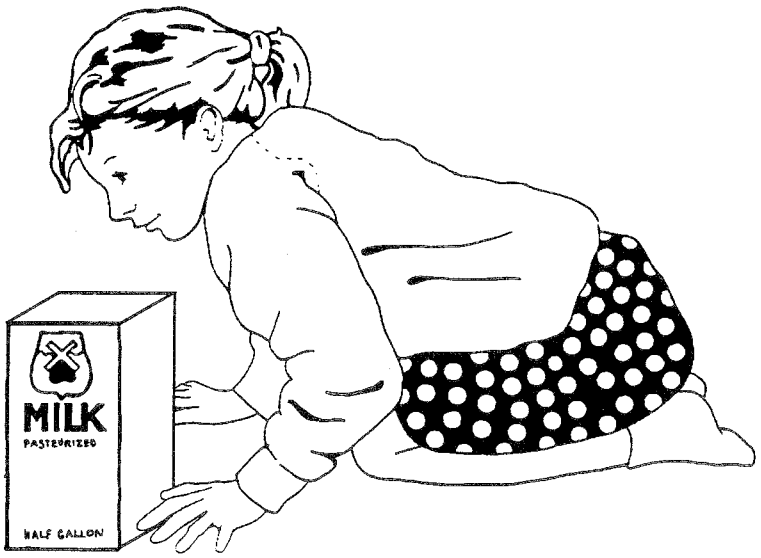
Spying Arthropods Underwater

Grades K-3

After making this simple viewer, students will be able to take a peek at arthropod life underwater. Many insect species live the larval stage of their lives underwater. Other insect adults use their legs like paddles to swim underwater. Students can use the viewer to observe the activities of these aquatic dwellers.

Materials: half-gallon milk or juice cartons, scissors, pieces of clear plastic wrap (approximately 18"x18"),
two rubber bands for each viewer and masking tape.

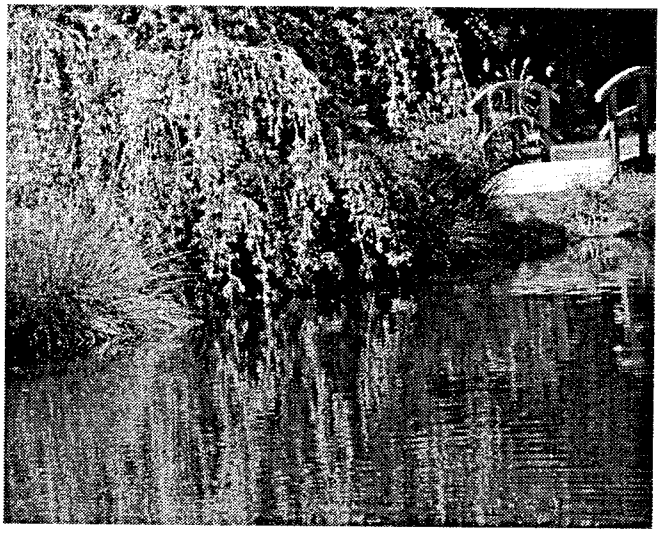
1. Cut off the top and bottom of the carton. Center one end of the carton on the square of plastic wrap.
2. Fold the plastic wrap up the sides of the carton and use tape to secure it in several places.
3. Put the rubber bands around the carton, near the end with the plastic wrap, to hold the plastic in place.
4. The underwater viewer is ready to use. Just put the plastic-covered end into the water at the edge of a pond or lake and look down into it. A magnifying glass can also be used inside the viewer to get a better look.



Pond Sampling

Grades 3-12

Th are many arthropods that spend all, or part, of the ves underwater. They utilize many of the dif nt microhabitats found in ponds, lakes, streams and other water sources. A microhabitat is a small habitat within a habitat. The microhabitat is created by environmental changes over a small area, such as colder water in deeper parts of a pond and warmer water at the edges of the pond. In streams, water can move faster in some places and slower in others. Each of these microhabitats is home to many species of animals. Different arthropods thrive in different regions of the water. In this activity, students can discover which arthropods live in water in local areas, how to identify them, and which arthropods inhabit different microhabitats of the water.



Materials: medium-sized white plastic container (preferably flat and wide), small plastic cup, magnifying glass, guide to aquatic arthropods such as Reid, George K. *Golden Guide: Pond Life*. New York: Western Publishing Co., Inc., 1987. ISBN#0307240177, or Borror, Donald J. and Richard D. White. Peterson First Guides: *Insects: A Simplified Guide to the Common Insects of North America*. Boston: Houghton Mifflin, Co., 1987. ISBN #093269117X.

Before heading out into the field, have your students research wetland microhabitats and aquatic arthropods. Students can learn to identify aquatic arthropods by using the field guide. You may want to take the field guides with you on your trip. Using information on aquatic arthropod feeding habits, students can make predictions about which arthropods they might expect to find in different microhabitats.

A: Base Sample

1. In pairs or small groups, have your students use the cup to scoop water carefully from a pond, stream, or lake into the white, flat-bottomed container.
2. Using the magnifying glass, students should spend several minutes observing the organisms moving in the water. Then, using the guide book(s), have your students try to identify the different arthropods they observe. If the students cannot positively identify the animal, have them draw and describe the animal thoroughly.
3. Students can make a data sheet, similar to the *Pond Sampling Data Sheet* example. The columns contain names for the different microhabitats the students plan to sample. The rows contain the names or drawings and descriptions of the different arthropod species the students find in their pond samples. Leave some extra rows at the bottom of the sheet for any species that may be found in the subsequent samples.

B: Additional Samples

1. Have your students try scooping from different areas of the water: deep, shallow, slow-moving, fast-moving, near rocks, near vegetation. Students should perform step two, below, at each location before moving on. Between each sample, students should return the water and animals to the spot the animals came from and carefully rinse the bowl and container to ensure no animals are left in either of them. If organisms from one location stay in the container, this could skew the data found in the next location.
2. As the students identify the arthropods they find, have them make tallies for the number of individuals of each species on their data sheets.
3. If students perform more than one sampling at each different microhabitat, they can then compare the average number of individuals of each species at the different sites.

POND SAMPLING

Data Sheet

Base Sample	Slow-moving water	Fast-moving water	Near rocks	Near vegetation
Caddisfly larvae				
Mosquito larvae				
Backswimmer				

POND SAMPLING

Questions for Study

Questions to be answered after samplings are completed:

1. How many specimens did you find?

2. How many different species did you find?

4. Which microhabitat had the greatest number of specimens?

5. Which microhabitat had the greatest number of species?

6. Why do arthropods live in many different microhabitats?

7. Why are there different species found in each microhabitat?

8. What was the significance of this study?

9. What was the most important discovery you made during this sampling study?

TESTING SENSES

Mealworm Senses

Grades 3-12

Observing animals can teach us about their natural behavior and biology. Through simple tests we can learn how animals move and sense the world around them.

A: In this activity students can make predictions about how they think a mealworm senses its world. Students will then build structures to test out their ideas.

Materials: mealworms, flour, glue, match sticks, toothpicks, Popsicle sticks, paper clips, cardboard and cardboard boxes.

1. Have your students closely observe mealworms moving around on a flat surface. They can use magnifying glasses to look at the mealworms' anatomy. As they are observing, students can develop hypotheses about how a mealworm locates food and avoids objects.
2. Discuss the students' hypotheses, then talk about how they might test their hypotheses. After discussing students' ideas, you can have students design and test their hypotheses.

B: To test whether mealworms use their vision and/or body parts to navigate, students can build a simple course of walls in a small cardboard box.

1. Sprinkle a thin layer of flour over the bottom of the box (thin enough so that the mealworm will not be covered by it).
2. Put a mealworm in the box.
3. Cover the box and place it in a dark place for a short period of time.
4. Remove the box and uncover it. Students can study and interpret the trails left by the mealworm and decide whether or not they think mealworms can navigate in the dark.

A variety of walls can be designed to test whether mealworms use other body parts to follow walls. A *very* low wall would allow only the feet of the mealworm to touch. A wall with a very low overhang could prevent the mealworm's feet from touching. Students can also observe what a mealworm does when it reaches the end of a wall. Does it continue straight along the wall until the hind end isn't touching anymore? Or does it stop following the wall as soon as its head goes beyond the wall? What would these actions indicate? Students should keep in mind the purpose of the walls they are building. The walls do not need to be too elaborate. Students should aim to test several different hypotheses rather than spend a lot of time building intricate structures to test one hypothesis.

Your students can design other ways to test their ideas about how mealworms navigate. When finished with their tests, students can present their findings to each other (singly or in groups). Have students describe their original hypotheses and how they came to their conclusions after performing the different tests.

GARDENING FOR WILDLIFE

Students can research different ways of using beneficial insects or attracting arthropods to their own backyard environments.

A: Butterfly Garden
Grades K-3
The class as a whole can design and plant a small butterfly garden at school. Contact local nurseries for information on plants that grow easily and attract butterflies. The garden can be planted in early spring, and students can watch for butterflies to come and visit their garden.

Grades 3-12
By reading books or contacting local nurseries or garden clubs, students can learn about what types of plants attract different animals, such as butterflies. Once your students have completed this research, they can design and plant a butterfly garden at home or at school. Note which plants seem to thrive in your garden. Make observations of butterflies that visit the garden. Which plants attract the most butterflies? Students can also use their gardens to teach other students at their school about the benefits of arthropods.

B: Beneficial Insects
Grades 3-12
Many arthropods help protect plants from other arthropods that can damage plants. Have your students find out where they can get some beneficial native insects to release in a garden at school or at home. Will they stay there?

It is important for students to make sure that any arthropods they will be releasing are native to the area. Arthropods from other regions may take over the niche of a local species, causing its population to decline. This negative effect would outweigh the benefits of introducing the non-native species.

Certain types of plants can attract beneficial insects, such as ladybugs, or encourage them to stay. Plants with umbrella-shaped flower heads, such as parsley, dill, fennel and carrot, often attract arthropods that people like to have in their gardens. Observe some of these arthropods in your garden. How are they helping the plants in your garden?

C: Gardening Without Chemicals
Grades 3-12
Gardening for wildlife is important, but if we use harmful chemicals, such as pesticides and herbicides, then we are not helping our environment. These chemicals can kill wildlife in our own backyards. They can also leach into waterways and affect fish and other animals depending on the water for survival.

Have your students explore other natural and non-chemical ways of discouraging pests, whether animals or plants, in the garden.

The following sources offer brochures on pesticide-free, arthropod-friendly gardening:

Seattle Tilth Association
4649 Sunnyside Ave. N.
Seattle, WA 98103
(206) 633-0451

WSU Cooperative Extension,
King County
506 Second Avenue, Room 612
Seattle, WA 98104-2394
(206) 296-3900
(800) 325-6165 ext. 3900

RESEARCH TOPICS

Grades K-12
Using the list of arthropod-related organizations provided, have your students explore and discuss the aims of entomology clubs and how the activities the clubs sponsor meet the clubs' goals. Students can contact various clubs and organizations to gain this information. Students can find out what they themselves can do to be involved in learning more about arthropods and arthropod conservation. This information can be shared orally with the rest of the class. The class as a whole could decide on a club to join or make lists of things they can do at home to be involved.

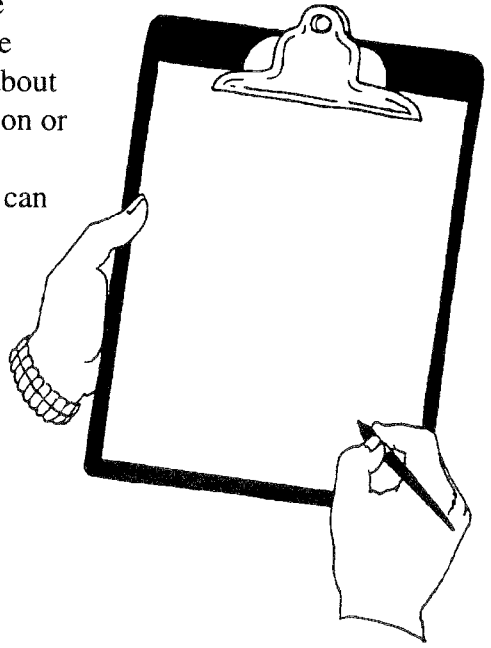
Grades 3-12
Many arthropods have played important roles in world history. They may have affected the demography (size, density and distribution of human populations) of certain areas in several ways, such as carrying diseases and affecting food production. Arthropods have been important in human cultures in roles such as food sources or spiritual symbols (e.g. scarab beetles in ancient Egypt). Humans have used observations of arthropod anatomy and behavior as inspiration for technological inventions. One example of this is the use of spiders' silk in products such as safety nets and lines, and telegraph wires. Have your students research examples of arthropods affecting human history. Students can write comprehensive reports about these examples including information about the time period, geographic location or culture involved, as well as the eventual outcomes. These reports can be presented orally.

Grades 3-12
Students can engage in a discussion or formal debate on the impact of human actions on animal species and the environment.

Example: Discuss how the deforestation of tropical rain forests might impact natural ecosystems or humans in the United States.

In the early 1990s, farmers in the Midwest began to notice increased populations of insects preying on their crops. Initially, people believed that the insects were just having a "bumper year" or two. However, as the trend continued, scientists began to speculate on other theories. Many people now believe that the increase in insects resulted from a decrease in the birds which normally preyed on the insects. Many North American migratory birds fly to rain forests of South America in the fall. As these birds lose their habitat in South America due to deforestation, their populations have decreased. Thus, there are fewer birds returning to North America where they normally consume huge quantities of insects.

What further problems might arise from the disappearance of migratory birds? These might include loss of crops, increased use of pesticides, and loss of animals which prey on the migratory birds.



After researching the problem, students can discuss or debate different approaches to the problem, possible conservation tactics and solutions.

Arts and Crafts

Natural Bugs

Grades K-6

Collect natural objects, such as maple seeds, acorns, differently shaped sticks or leaves.

Students can use their knowledge of arthropod body characteristics to create arthropods from the objects. Use glue, string and paint to connect the parts and decorate the arthropod.

Example: Dragonfly - straight sticks and four maple seeds for wings.

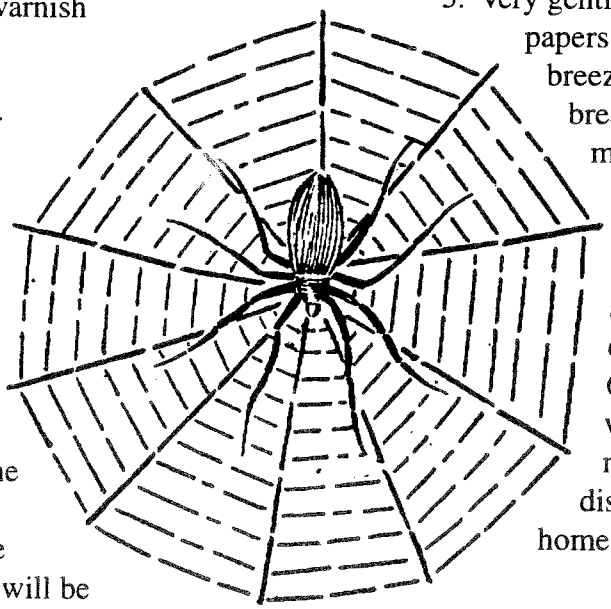
Natural Bugs can be displayed in dioramas or several can be hung together to create a mobile. When making dioramas, have students think about the arthropod's natural habitat and what it might find to eat in its environment. Students should make sure to include these elements in the diorama. Mobiles can be used to help students think about interactions between arthropods. For example, a mobile could include a predatory arthropod and other arthropods it likes to eat.

Collecting Spider Webs

Grades 3-6

Materials: sturdy white paper (card stock or poster board), 2 ft. x 2 ft. (depending on size of web), black spray paint, clear spray varnish (optional).

1. Working in pairs, have your students locate some spider webs. Because of the sunlight reflecting on the morning dew on the strands, it is usually easier to see webs in the morning. Think about where spiders might like to live and look there (under the eaves of buildings or in tall grass or shrubs). During late summer and early fall there will be many webs, but it should be possible to find webs anytime.



2. Have your students check the web carefully, without touching it. If they see babies, eggs or food on the web, select another web. If the web is empty or there is only an adult spider, you can use the web. With a blade of grass, carefully tickle the spider to make it leave (this will not hurt the spider and it can return and build another web after your students leave).
3. Have one student of the pair spray both sides of the web with paint. The other student should hold a sheet of newspaper up behind the web to avoid spraying flowers, walls, or other objects. This student should stand to the side to avoid being sprayed. Be sure to spray gently and not too close (about two feet away) to the web or it may tear. The students should try to use as little paint as possible.
4. After spraying the web, have the student who was painting hold the white paper parallel to the web and slowly move it toward the web until it touches. The web will stick to the paper, but STOP here. Ask the other student to break (carefully!) any of the strands longer than the paper and bend them over so they stick onto the back side of the paper. This is important so that the web keeps its shape.
5. Very gently, have your students carry their papers and webs to a protected (not breezy) place or inside. The webs can break easily if the paper is moved too much. Let the webs dry for about 15 minutes. Remember that nothing can be set on top of the webs nor can the sheets be stacked or the webs can be damaged.
6. Students can spray their webs with clear varnish to protect them more permanently. Webs can be displayed in the classroom or at home.

Lunching With Bugs!

Getting enough protein? Have you thought of having an arthropod snack? Many of us eat crustaceans such as lobsters, crabs or shrimp, but have you ever considered eating a bug, like maybe a cockroach? People around the world, in Asia, Africa, Australia and Latin America have had all types of arthropods and insects on the menu for a long time!

In Japan many types of water insect larvae are eaten as well as other insects, such as grasshoppers sautéed with a little soy sauce. Mealworms, which are beetle larvae, are very popular in some places as a topping for pizza or spaghetti; they can even be fried and put in cookies to add a little crunch. Stir-fried cockroaches are another specialty in many countries. We often think this sounds gross because we are not used to eating insects. However many insects are high in protein and some, such as leaf-cutting ants, have no cholesterol.

Many scientists recommend that we start harvesting insects for a food source instead of mammals such as cattle, which give us beef. Insects do not require as much space to grow, they can provide us with many nutrients we need and they use much less of our natural resources than raising cattle, pigs or chickens. If you are brave, give it a try and discover a new source of protein.

Here are some more examples of how different arthropods are eaten throughout the world:

Women in the Nile Valley used to delight in eating churchyard beetles and scarab beetles. They did this to gain weight quickly so that they would be considered more beautiful.

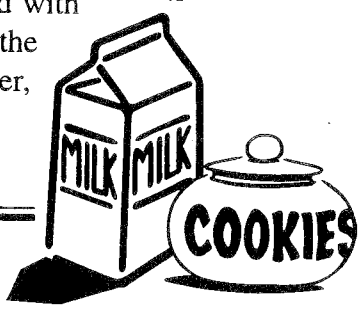
Native Australians dig into the ground looking for honeypot ant workers. Some of the worker ants serve as storage vessels for the sweet honeydew collected from other insects.

Many people in southern parts of Africa eat "mopane worms," large caterpillars that live in mopane trees. The caterpillars are usually eaten dried or fried in oil with onions.

In Venezuela, tarantulas are often toasted over an open fire. The white meat of the spider's head and body are said to have a nutty flavor.

If you go to a restaurant in Japan, you may be able to order hachi-no-ko (boiled wasp larvae) or sangi (fried silk moth pupae), among other insect treats.

In Bali, dragonflies are captured by using a long stick tipped with latex (a sticky substance from plants). Tap the dragonfly with the stick and it is stuck! The dragonflies may be boiled with ginger, garlic, shallots, chili pepper and coconut milk.



Mealworm cookies:

Grades K-12

Materials: mealworms and the ingredients for your favorite cookies.

Purchase mealworms. Many pet stores sell them or you can get them in bulk from pet store suppliers.

Wash and place the mealworms on a cookie sheet. Place the sheet in an oven at 250° and bake until the mealworms are golden brown and crunchy. Watch them carefully so they do not burn. Mix up your favorite cookie recipe (I recommend chocolate chip cookies) and add the mealworms to the batter. Then pop the cookies in the oven. Once they are done, grab a glass of milk and sit down for a new experience! I think it tastes like adding a crispy cereal to your cookie!

Check it out:

Grades 3-12

Go to the library, search the Internet or talk to people who come from different cultures. See how much you can find out about the different types of foods people eat! Write a report on a new food dish you had never heard of before. Can you get your classmates to try it? Or, in small groups, make oral presentations to your class about different ways arthropods are used by people in different cultures.

After sharing some information about eating insects and other arthropods, encourage students to discuss the benefits and/or drawbacks for a community when they use "bugs" as a food source. Students can consider environmental impacts, nutritional effects and economic issues.