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ABSTRACT

Information about the insect world and its advantages for the elementary classroom teacher is given in this paper, along with activities which can teach students about insects. The insect world tends to be noticed by the average person only when the small creatures become pests or inhabit man's abode. However, young students have a sharp sense of curiosity and are usually fascinated with insect activity. The teacher should use these characteristics to her advantage since the insect world is readily accessible through much of the school year. The teacher can combine this study with other regular subjects. Among the various activities recommended are: making an observation data chart; taking a field trip to study the noise made by various insects and recording them; mapping their activities; studying the relationship between 2 or 3 kinds of a certain insect; mapping travel at night; making a checklist of habitats or niches; collecting insects; making plaster of paris fossil imprints of insects or their homes; and identifying insects found on a single plant. The activities given include both outdoor and classroom activities. (NQ)

EXPLORING THE INSECT WORLD
AN OUTDOOR TEACHING TECHNIQUE

by
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The world of the insects is one that is only acutely noticed by the average person when the small creatures become pests or they inhabit the same abode as man. However, the insect world is a fascinating and rewarding environment for exploration. It is ready to reveal its innermost secrets if one can stop long enough to study its minute and manifold activity. This intriguing realm is at our doorsteps, in our gardens, lawns, woods, fields, and even in the least expected places adjacent to or in our living habitat. There is scarcely a place on the planet that is not home to at least one kind of insect.

Man shares the planet with these little creatures, yet there is much in their lives that remains unknown. They are, nevertheless, very impressive for they can do many of the things that man does and sometimes with a greater degree of efficiency. There exist insects which are builders and can construct living quarters as intricate as those of man. There are insects who are farmers that raise crops and in some instances even herd other insects from which they extract a sweet liquid. There are insects who are carpenters, papermakers, and even morticians of a sort. Some insects live in well organized societies that rival or excell those of man in terms of complexity and efficiency.

To many people watching insects can be laborious because of their small size which requires close observation usually with a hand lens or magnifying glass. The small size of insects is advantageous for survival. They demand very little from the environment and they are able to occupy tiny niches in the environment where they can find protection and food at the same time.

Most young people are gifted with a sharp sense of curiosity and they are usually fascinated with the life activities of insects. These characteristics of young learners are advantageous to the elementary classroom teacher. A distinct advantage to a teacher of an elementary school class is that insects are readily accessible through much of the school year. It is far easier to explore the world of these small animals than it is to explor the world of larger ones such as the mammals. The reason for this is that there are many more insects than there are larger animals and they live in closer proximity to man. It is estimated that there are over 7000,000 different kinds of insects in the world. It has been said that if one of each species were allowed one inch of space in a line, it would extend beyond ten miles in length. Impressive as this is, one must remember that there are millions of each species and this is another advantage to the teacher who wishes to explore this miniature world with a class of students.

The first step that a teacher can take is to define to the class just what is meant by the word insect. One popular method is to have the students read the definition of the word insect from their classroom dictionary. One such definition is contained in fifth edition of the Thorndike Barnhart Beginning Dictionary and reads as follows: "insect, 1. any group of small animals without a backbone, with the body divided into three parts. Insects have three pairs of legs and usually two pairs of wings. Flies, mosquitoes, gnats and bees are insects. 2. Any similar small animal with its body divided into several parts, with several pairs of legs. Spiders and centipedes are often called insects."

There are certainly weaknesses to be found in the definition of an insect presented by any dictionary. In the Thorndike Barnhart definition spiders and centipedes are insects. They are not considered insects by a scientific definition because they are not segmented into three parts (the spider has two parts,) the centipede has one) and do not have six legs. It is up to the teacher to capitalize on what she knows an insect to be and begin to delimit as to what is meant by calling an animal an insect. The definition contained in the dictionary is not a very scientific one and it simply conveys how the word is used by the general public. Nevertheless, it is an excellent device to begin a study of insects.

Bringing pictures of insects to class or by showing slides of insects the teacher can begin to evolve a simple definition that is clearly understood by all of the students. The definition should emanate from the students own study of the physical characteristics of an insect. Students can bring live specimens to class and they can study the insect structure under magnification (hand lens) and list the main parts of the insect. The data accumulated can be correlated with the definition appearing in the dictionary to ascertain if the definition is accurate. A student definition might read as follows: "An insect is an animal that has six legs (three pairs), three definite body parts, and usually two pairs of wings." Going back to the dictionary the class can begin to eliminate the animals that do not fall under their definition. They can begin to eliminate spiders, scorpions, earthworms, centipedes, and even turtles. At this point the students can begin to visualize what an insect really is and how it compares to other kinds of animals that are often mistaken for insects.

There are certain characteristics which are general to most insects and they are as follows:

1. An insect has an exoskeleton which means that its body is covered with an outer shell that serves both as a protective shield and also as a place for the muscles to insert themselves. Therefore, insects belong to a class of animals known as invertebrates (animals that do not have a backbone or verterbral column.)

2. The insect's skeleton is divided into segments instead of being solid like that of a snake. Many invertebrates are not segmented like an insect. An earthworm is an example of this and could be utilized as a point of comparative reference.

3. The legs and antennae of the insect are jointed. This places the insect into the phylum (primary division) known as Arthropoda, or jointed-legged animals, which includes other creatures such as crabs, spiders, centipedes, millipedes, crayfish, and scorpions.

4. The insect has one pair of antennae or feelers on its head. Centipedes and millipedes also have one pair although not classified as insects. Some arthropods have two or more pairs except for the Arachnida which do not have antennae.

5. The insect which is fully mature has three major parts to its body: the head, the thorax, and the abdomen. Spiders, scorpions, centipedes and other related animals only have two main body segments, namely the head and the abdomen.

6. The mature insect has three pairs of legs used for walking purposes. Spiders have eight legs and four pairs. Of course centipedes and millipedes have many more legs.

7. The mature insects have two or one pair of wings or in some cases no wings at all. Most insects with one pair of wings have in place of a second pair evidence of degcnerate wings. These appear as small knob-like projections known as halteres.

The above listed characteristics of an insect can be utilized in the development of an insect observation data chart. This technique utilizes a five by eight index card which is divided into the seven characteristics of an insect. By using this data chart the students can begin to classify small animals into the insect family. Sometimes the students will find what they think are insects and when tabulated into the data chart they find that they are spiders or other related creatures. Additional information about the characteristics such as number of wings, length of thorax and abdomen, color, size, method of locomotion, locality found, food source will aid the students in identifying the insect back in the classroom. This technique also permits the teacher who is not familiar with insects to do field work with the class and lead them in explorations which will result in greater understanding of the insect world. A teacher does not necessarily have to be an entomologist in order to provide direct experiences for students interested in learning more about these small creatures which abound in both their cultural and physical environment.

One of the first signs of nearby insects to a group of students on a field trip is the number of noises made by insects. There are the call of the cricket, the repeated call of the locust and the Katydid, the hum of bees, the shrill call

of the Cicada, and the other noises made by a variety of insects. An insect noise data chart can be developed for use in the field by students. One heading on this data chart can be the interval between calls or noises of the insect. The students can time the number of insect calls per minute and record this number on the data chart. This chart can also be duplicated on 5 x 8 index cards for easy handling in the field by students.

The tempo of the cricket, for example, depends on the temperature so closely that one can often tell the air temperature by counting the number of chirps per minute, dividing the result by four and adding forty. Thus, if the students count one hundred chirps per minute, the temperature will be approximately sixty-five degrees.

A description of the kind of sound made by insects can be another heading for the data chart. Some sounds will be low, some will be high, some will escalate in an ascending crescendo, while others will descend in decreasing intensity.

Another heading on the data chart might be the tone of the call or noise made by the insect. Does the noise go from high tones to low tones or from low tones to high tones? Some sounds made by insects are very repetitive and vary little in tonal quality.

Another question for data accumulation about insect sounds in one of whether the noise ceases when the students approach the location of the insect. The insect sounds will vary from specie to specie from chirping, humming, buzzing, singing, clicking, rasping, etc. A description of the sound will require a good

choice ofadjectives or verbs which will tax the physical perceptiveness of the students. Rythmn can be another heading for the data chart as well as the location of the source of the call or noise.

A portable tape recorder and an inexpensive parabolic ear can be invaluable in collecting the various sounds made by insects. A symphony of insect sounds played by these miniature musicians can be taken back to the classroom for further analysis by the students. The tape can be cut and spliced for an orchestral presentation or exhibit for the whole school to enjoy.

Insects are the world's first sound makers. However, not all insects make sounds for there are many which do not emit any sound at all. In fact, the majority of the insects of the world are silent. Sounds of different kinds are produced by various numbers of species dispersed throughout a few orders of insects. The sound is entirely instrumental for an insect possesses no lungs and consequently have no true voice. From early spring to early fall the vast insect orchestra plays its symphony in the woods, fields, marshes, lawns, and even in the urban areas such as towns and cities. Both during the day as well as the night there is the endless, rythmical and monotonous sound of these little musicians.

Insects produce sounds in different ways. Only insects in captivity and in a simulated natural environment can be studied closely by the students with reference to method of sound production. The following ways are known methods by which the more common sounds are produced:

1. By the vibration of wings. Many insects produce a humming or buzzing sound when in flight such as the bumble bee, the honey bee, the dragon fly, and

the bothersome mosquito.

2. By the tapping of some part of the body against an object. An example of an insect making this type of sound is the beetle which burrows into a tree, log, or old furniture. These beetles make a tapping or ticking noise which is believed by some scientists to be mating calls. The sound is produced by the beetle striking its head against the wooden side of the burrow that it has made. Some insects such as termites not only make noises with their heads but also make clicking noises with their jaws.

3. Another method of an insect producing sounds are those made by the vibration of special membranes which are controlled by muscular activity. The cicadas are an example of insects which produce sound in this manner.

4. Another method of producing sound by insects is that made by friction caused by rubbing one part of the body against another. Many grasshoppers make sounds in this manner. Some species make a rasping sound by rubbing their hind legs against their front wings or the wing covers. Some grasshoppers have a simpler way of making sound. During flight they rub the upper surface of the upper margin of the hind wings upon the lower surface of the thick veins of the front wings. Some grasshoppers simply make sounds by just opening their wings and moving them in flight.

Exploring the area of sound production can be exciting for the students and is especially true when the insects can be observed closely as they produce sound. A further activity concerning the sound production of insects is to observe how man has attempted to recreate insect sounds both in his music and in his literature.

The early Greeks regarded cicadas as sacred and they kept them in cages to hear them sing. The Greeks even wrote poetry about them and it has been interesting to note that a Greek harp even had a symbol of cicada on it. There have been many poets and writers who have written about the activities of insects. One poem written by an eleven year old girl was very expressive of the general attitude many people have concerning insects. It reads as follows:

Insects[1]

They eat our carpets and munch our clothes,
Spread disease and damage our homes,
Spoil our picnics and wreck our fun,
I'd like to get rid of every single one.

(Sandra, age 11)

It would be interesting for the teacher to correlate this outdoor science activity with the language arts unit that the class is currently engaged in.

Another fascinating activity for a class to become involved with during a study of insects is to map their activities. The mapping of insects can be simple or it can be very complicated, depending upon how involved the teacher wants the class to become or upon the level of the class in terms of handling a mapping assignment. It is always better with a beginner group to start with simple maps first. The only material that the class needs for simple maps are: a piece of paper or data pad, a pencil, a ruler, thumbtacks, some string, and a drawing compass. Take the class to the school grounds, a local park, a vacant lot, or a field where insects are in abudance and the insect selected for mapping can be found. The class can study one specific insect or the relationship between two or three kinds such as the ant and the aphids (ant cows as they are sometimes

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[1] Gega, Peter, Science in Elementary Education. New York: John Wiley & Sons, Inc. 1966, p. 406.

called). A quadrat or a rectangular area can be staked out and divided into squares with each having the same diameter. String can be utilized if the area is covered with grass or other vegetation. If the ground is bare, it can be marked off by simply scratching the lines with a stick.

Have the students mark a similar plot on their data sheets. A scale can be established with one inch equaling a certain distance such as a foot or more, Large squared graph paper can also be used. Have the students next draw all the large vegetation such as trees, shrubs, and grass areas on the map. Objects such as large rocks, posts, and other objects should also be included. Ridges or elevations should also be marked on the map. The class can be divided into three or more smaller groups with each group marking off their respective area.

Have the students select an insect or several insects for observation. The students should use a broken line illustrated by dots or dashes to demonstrate the path taken by the insect. Each insect studied should have its own specific path marked by either dots or dashes or long and short dashes. If more insects are included combinations of dots and dashes can be employed. Follow the insects' activity within the quadrat. Whenever an insect meets another insect or object it should be recorded on the map by a number. Each map should have a legend which identifies what the numbers and other entries to the map indicate. More detailed accounts of the insect's adventures can be recorded in the data book. This simple mapping can be the beginning experience for a class of students studying the movements of insects.

Another activity could involve mapping ground traveling insects with a circle instead of a quadrat. Draw a circle on the bare ground or if ground is covered with vegetation, stake the circle with string. The center of the circle should

be established. This will be easy if you place a stake in the ground and tie a four or five foot string to it. Establish the circle by using the center stake as a focal point. The students can observe the insect's rate of travel in relationship to temperature. Insects can be observed during sunny days and during overcast days when the sun is not shining. The insect can be placed in the center of the circle and the amount of time it takes to reach the outer edge of the circle can be measured. This same experiment can be repeated with insects of the same species or different species to see if rate of travel varies. A small circle can be drawn to scale on the map sheet. Rates of speed and paths traveled can be recorded. Temperature of the air should also be recorded.

Another type of map could involve flying insects such as bees, which are attracted to flowers. Vegetative mapping of the flowers should be done first. Care should be employed as to detail for this will give much more valid data. Students should map from what direction insects come from to the flowers. Do all the bees of same species come from the same direction? What is the position of the sun in relationship to the insect's approach to the flower? Is the flower shaded when insects approach it? Do insects employ the territorial imperative when they are at a flower? Do they tolerate their own kind and drive away others? These are some of the questions that might be answered from the data entered on the map.

Maps can be made of insect travel at night. The position of the moon can be recorded in relationship to the path taken by the insect. The students can experiment with a flashlight and see if introduced light has an effect on the travel pattern of the insect under observation. The same thing can be accomplished by

utilizing the flight direction of insects with reference to introduced light. This experiment could be conducted inside a darkened school classroom. Maps can also be made of water insects such as the water scorpions, water striders, back-swimmers, water boatman, giant water bugs, whirligis beetles, water scavenger beetles, predaceous diving beetles, broad-shouldered bugs, springtails, and other insects moving near or on the surface of water. A map can be made of a specific area of surface water and particular insects can be mapped with reference to their movements, encounters, and other activity. If the body of water is small enough, string can be used to designate the limits of the area under observation.

Insects that fly over a body of water such as a pond or stream can also be marked. An excellent insect for this type of mapping is the dragon fly. Damsel-flies, bees, butterflies, Mayflies, stone flies, some moths, also provide opportunities for mapping their activities and flight movements over or near water. The same principles apply in making a map of water based insects as applies to the land based insects.

Another activity that the students will enjoy doing is the development of a checklist of insect habitats or niches. The checklist could be developed under several broad headings. These readings could be as follows: insects found in fresh water, insects found along the edge of fresh water or salt water, insects found on land, and insects found in the soil or under leaves, rocks, old boards. These main headings could have sub-headings such as: insects found on the surface of water, in fast or slow moving water, below the surface of water, on rocks or debris under the water, on water plants, on the bottom of water area, in the sediment, flying over or near the water, near or in salt water, insects found

on plants, under bark of trees, inside stems of plants, in hollow trees, in decaying matter, under leaves, living in burrows of trees or other woody plants, on or in roots of plants or trees, on or in fruit of plants, on or in flowers, on live leaves, inside cones of coniferous trees, in galls, in seeds, under, in, or on mosses, lichens, ferns, mushrooms, in the nests of birds or rodents, on the bodies of animals, etc.

These are only some of the locations where insects can be found. An insect garden can be developed right on the school grounds. Boards, rocks, leaves, rotted logs, stumps can be introduced as possible habitats for insects. Plantings such as flowers, shrubs, and non-woody plants can be initiated as a part of an insect garden. A pile of decaying matter such as a compost pile can encourage insects to inhabit this niche if they are inclined to do so.

A light (illuminated) trap can also be established near the school building. A white sheet can be placed behind and under the light. Insects can be collected in the morning for further study in the classroom.

Sweet traps can be made out of juice cans or larger cans to capture ground walking insects. These traps can be baited with any sweet material such as honey or molasses. Sweet traps can also be placed in deserted city dwellings as a part of a unit for studying the ecology of a deserted building.

Insect nets can be made out of old broom stick handles, wire coat hangers and old curtain material. Each youngster can make his own insect net and a cone made of the curtain material can be fastened to the wire circle made from the coat hangers which in turn is fastened to the broom handle. Directions for making this homemade net is found in many science texts and insect books.

Students can then learn to sweep fields and meadows for flying insects as well as those who hop like grasshoppers, crickets, leaf hoppers, springtails, etc.

By using two coat hanger wires an insect net for aquatic insects can be devised. The added strength of two strands of wire will enable the students to dip in the water or perhaps even investigate the bottom of the water area.

Another activity with insects might involve making plaster of paris fossil imprints of the insects. The cockroach, for example, when imprinted in plaster of paris will be similar to the fossil imprints made in a natural way during the Carboniferous Period dating back 320 million years. This would stimulate motivation for research into the evolution of insects and their extreme adaptability to the vicissitudes of life. The classroom made fossil imprints could become a beginning of a permanent insect collection.

Another activity with plaster of paris is to get an impression of insect homes such as mud daubers' nests, paper wasps' nests, insect galls, etc. The honey bee hive makes a beautiful pattern when plaster of paris is used for an impression of this intricate and complex insect home. Of course, it is advisable that the homes of the stinging insects be vacated before attempting to make a mold from them.

Back in the classroom a chart of all the insects found can be plotted. This central chart can have the following readings for each insect: where found, locomotion, food, protection, abundance, use to nature, eggs, where eggs are laid, number of eggs, incubation period of eggs, growing stage (nymph or larvae), where larvae or nymph are found, their method of locomotion, food they eat, enemies of

larvae or nymph, protection, use to nature, etc. Of course, some of the information may have to be gleaned from reference books.

A wire coat hanger formed into a circle can be used to obtain an approximate percentage of insect incidence. Find a spot where there are many insects such as ants. Toss the wire circle randomly twenty times. If an insect appears within the circle, place a check mark on the insect analysis chart. Even if more than one insect of the selected kind appears, it is still counted as one check. Working with the ant as insect A, if it appears ten times out of twenty, then the percentage of incidence is 50%. Have the students vary the direction in which they toss the ring. Repeat the activity with another insect such as beetles.

Another interesting activity in the field is to find a rotted log or stump and chip away a section of it. Remove the bark carefully and then have the students cut or pull the wood to bits. The students should collect all the insects they find as well as other small animals. The students should keep some alive and preserve some of each kind. A killing jar is good for preserving the insects for further study when back in the classroom. A knock-out bottle can be made from a half-quart glass jar that has a lid. A small vial could also be used and would be easier to carry in the pocket. If a jar is used, then adhesive tape can be placed around the bottle with an adhesive tape handle emanating from the encircling tape. This will facilitate ease in carrying. The jar or vial should have the following items in sequence at the bottom: fine saw dust, then a layer of blotting paper, then a layer of plaster of paris. Paper towel strips are placed in the jar to prevent the insects from tangling and towel strips also serve to keep the jar dry. A hole should be made in the plaster of paris by

leaving a pencil until the plaster is almost dry. This hole will allow nail polish remover (ethyl acetate) to saturate the sawdust through the blotting paper. Plug hole with cotton until it is time to refill. Avoid using cyanide with young students. Cyanide fumes are deadly poison and can be harmful.

If students are interested in mounting their insects as a collection, then a relaxing jar is needed. This quart or half-quart glass jar should have a layer of sand at the bottom and should be covered by a fitted piece of cardboard. The sand should be moistened with water first and then a few drops of carbolic acid is added. In several days the insect specimen should be pliable enough for mounting. A spreading board may be necessary for the larger flying insects such as moths and butterflies. Spreading boards can be made of pine, balsa, cardboard, or cork.

An old cardboard cigar box can be used to house the mounted specimens. Students should place layers of sheet cork, styrofoam, and corrugated cardboard in the bottom of the box. Moth crystals should be placed in a corner of the box and they should be wrapped in cloth. This will preserve the specimens from damage by smaller insects which may eat away at the specimens.

Directions for the correct ways of pinning insects are depicted in many books on insects. A straight pin can be used. A small label should be first and include the name of the specimen. The common name will suffice; however, the students may want to include the Latin name. The next label should have the name of the collector and a file number of the insect specimen. The next label should include the locality and date of where and when the specimen was obtained. The last item pierced by the pin is the insect specimen.

Young students are naturally collectors and a small collection of insects will appeal to them both as an individual project or as a class project.

There are many other study activities with insects. A few of them include:

1. Counting the number of insects caught in the radiator of an automobile after a trip through the rural countryside.

2. Identifying and listing the kinds of insects found on a single plant. The part of the plant on which each insect is found should be recorded. The insects should be classified as to whether they are leaf eaters, stem feeders, predators, parasites, nectar eaters and juice suckers. A data chart could be devised from these characteristics of insects found on a single plant.

3. Racing insects in a specially built raceway made from a long cardboard box. Runways or tracks can be divided and insects of the same type or different types can be timed. Favorite food of each insect can be motivation for walking to the other end of raceway. Observe the insects, especially the larger beetles, as they walk. Do they move all the legs on one side at the same time? If a leg is lifted or moved on one side, does the leg on the opposite side also move? Repeat the activity in a darkened classroom using a flashlight or light with colored filters. Do the insects react more energetically to one color rather than another? Repeat the activity out-of-doors and change the location of the box in relationship to the position of the sun. Do the insects navigate by the position of the sun? Use a magnetic compass to see if they always move in the same direction regardless of the position of the box.

4. With a hand lens examine the legs and feet of insects that walk, jump, crawl, run or swim. How are these appendages adapted for locomotion in the insects' natural environmental niche? Are there other parts of the body that are

adapted to a specific environment?

The following outdoor teaching lesson is offered as a suggestive one for studying insects with an elementary school class:

Topic: Observing Insects on Dry Land
Objectives:

1. To develop skill in observing insects in a variety of land based enfironmental niches.
2. To develop skill in completing information required on the insect observational data chart.
3. To be able to distinguish between insects and other related animals.
4. To develop skill in collecting living insects for further study in the classroom.

Concepts:

1. Insects are animals that have three body segments, six legs, and usually two pairs of wings.
2. Almost every kind of available food material on land is fed upon by one or more types of insects.
3. Some insects live on plants while others are found living in a variety of environments.
4. Insects have tremendous variation.
5. Some insects have protective coloration.
6. The most abundant and diversified of all kinds of living animals on earth are insects.

Vocabulary:

head	niche	pupa
thorax	environment	gall
abdomen	larvae	antenna
segmented	nymph	Arthropoda
predators	parasites	nectar
pollen	mandible	

Material:

Hand lenses	data pad	string
insect nets	observation data chart	pencil
insect references	beating net	thermometer
knock-out jars	magnetic compass	

Instructional Procedure and Activities:

1. Introduce a definition of insects by reading the definition contained in a dictionary.
2. Show pictures or slides of insects and have the students identify the physical characteristics of insects.
3. Develop an observation data chart for use in the field. Include such items as size, locomotion, number of legs, number of wings, sound, location, food source, etc.
4. Make insect nets out of old broom handles, wire coat hangers, and cheese cloth or curtain material. Make killing jars or vials for use in the field.
5. Have the students go to a place where insects are to be found and have them sweep their insect nets back and forth a dozen times across the tops of green grass and weeds. Put the caught insects into a quart jar and observe the number and variety of insects caught.

6. Have students sit quietly in a field of grasses, weeds and wild flowers or at the edge of shrubs or wooded area and listen to the sounds of the insects.
7. Have the students observe and record all the kinds of insects they can find on a single plant. Have them record the part of the plant where each insect is found. Have the students classify the types of insects such as predators, parasites, leaf eaters, nectar feeders, juice feeders, pollen eaters and stem feeders.
8. Have the students find an old log or stump and remove a section of it. Have them break the wood apart bit by bit. Have them collect all the insects and other small animals they can find. Have the students with reference books and through observation learn more about the behavior of insects found in this habitat.
9. Have the students complete the observational data charts back in the classroom and begin identification of the "catch" insects.

Evaluation:

1. How do insects live and what do they do if we observe their body characteristics?
2. What features of form, structure, and behavior adapt insects to live in all the habitats and use all the kinds of food available to them?
3. How many body regions, wings, and legs do insects have?
4. In what locations did you find insects to be most abundant? What was the position of the sun? What was the air temperature? Did the location provide ample protection and food?

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