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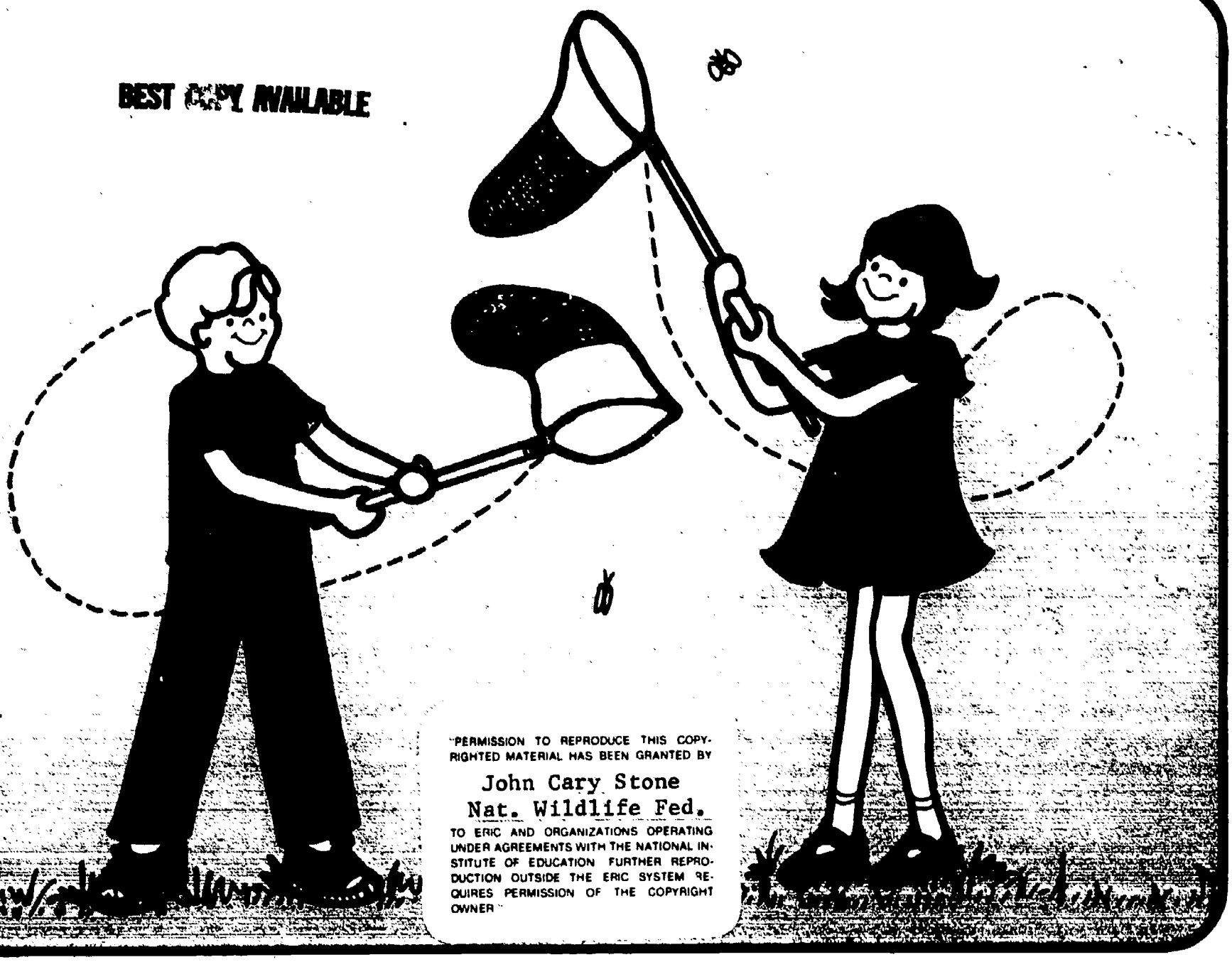
ABSTRACT

This environmental unit is one of a series designed for integration within an existing curriculum. The unit is self-contained and requires minimal teacher preparation. The philosophy of the units is based on an experience-oriented process that encourages self-paced independent student work. In this unit, students make a line transect and then study the different organisms found along it. Preliminary activities are concerned with familiarizing students with techniques of measuring temperature, light intensity, wind direction, and kinds of organisms. Next, students prepare the materials to be used at the field site. On the field trip, students collect as much data as possible along their transect. At a classroom debriefing session, students discuss their findings and attempt to identify interrelationships. The activities include a list of materials needed, directions for building the equipment, data collection techniques, and questions for discussion. The latter half of the unit is devoted to sample graphs and data sheets that can be duplicated for the students. Suggested grade levels for this unit are 3-9. (MA)



THE ENVIRONMENTAL UNITS

This is one of a group of Environmental Units written by the Environmental Science Center and published by the National Wildlife Federation.

In both theory and practice education is the essential base for long-range local, regional and national programs to improve and maintain the quality of environment necessary for man's welfare and survival. Citizens must be aware of ecological relationships in order to recognize, appreciate and fulfill constructive roles in society. This awareness should be launched through the existing educational process—in classroom and related school activities. No special courses on ecology can replace the need to integrate ecological learning throughout the existing curricula of our school systems. Furthermore, the life-styles and value-systems necessary for rational environmental decisions can best be acquired through repeated exposure to ecological learning which pervades the total educational experience.

It was with these thoughts that we developed these curriculum materials. They were designed for the classroom teacher to use with a minimal amount of preparation. They are meant to be part of the existing curriculum—to complement and enhance what students are already experiencing. Each unit is complete in itself, containing easy-to-follow descriptions of objectives and methods, as well as lists of simple materials.

The underlying philosophy throughout these units is that learning about the environment is not a memorization process, but rather an experience-oriented, experiment-observation-conclusion sort of learning. We are confident that students at all levels will arrive at intelligent ecological conclusions if given the proper opportunities to do so, and if not forced into "right" answers and precisely "accurate" names for their observations. If followed in principle by the teacher, these units will result in meaningful environmental education.

In the process of development, these units have been used and tested by classroom teachers, after which they have undergone evaluations, revisions and adaptations. Further constructive comments from classroom teachers are encouraged in the hope that we may make even more improvements.

A list of units in this group appears on the inside back cover.

About the National Wildlife Federation—1412 Sixteenth Street, N.W., Washington, D.C. 20036

Founded in 1936, the National Wildlife Federation has the largest membership of any conservation organization in the world and has affiliated groups in each of the 50 states, Guam, and the Virgin Islands. It is a non-profit, non-governmental organization devoted to the improvement of the environment and proper use of all natural resources. NWF distributes almost one million copies of free and inexpensive educational materials each year to youngsters, educators and concerned citizens. Educational activities are financed through contributions for Wildlife Conservation Stamps.

About the Environmental Science Center—5400 Glenwood Avenue, Minneapolis, Minnesota 55422

The Environmental Science Center, established in 1967 under Title III of the Elementary and Secondary Education Act is now the environmental education unit of the Minnesota Environmental Sciences Foundation, Inc. The Center works toward the establishment of environmental equilibrium through education—education in a fashion that will develop a conscience which guides man in making rational judgments regarding the environmental consequences of his actions. To this end the Environmental Science Center is continuing to develop and test a wide variety of instructional materials and programs for adults who work with youngsters.

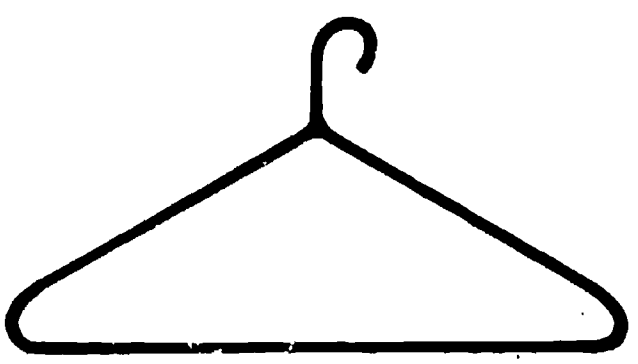
Transect Studies

An Environmental Investigation

BY

NATIONAL WILDLIFE FEDERATION

MINNESOTA ENVIRONMENTAL SCIENCES FOUNDATION, INC.



Design and Illustrations by
JAN BLYLER

Transect Studies was developed to prevent youngsters from growing up thinking that natural objects are isolated, separate entities. It is important that they realize how all elements of the environment work together and affect each other —man, of course, included. Specifically, by partaking in the activities of this unit, the students will see links between light intensity, temperature, moisture, plant distribution, insect types, soil, and wind. The exact *nature* of these links will not be explored in the body of the unit. For the time being, it is sufficient that students know, for certain, that the links exist.

Our hope is that by seeing the vast network of interactions in a community, the students will realize that they too are sharing space and dependent upon the well-being of their environmental neighbors. This unit is designed to be a starting point. The offshoots are limited only by your imagination.

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INTRODUCTION

A **transect** is a line which is used as a guide. The line can be imaginary, selected according to some arbitrary endpoints, or it can be guided by something external which in itself forms a line—like a street or a river. Even a fallen tree trunk would be appropriate, depending on the scope of your purposes.

This unit aims to help students become aware of certain interrelationships in nature through investigation of life forms found on a transect. By designating a transect and taking samples at regular intervals along that transect, the students will have a means of systematically investigating changes in a habitat.

The unit starts off with some preliminary activities which will give the students a feel for techniques they will use during the major field site investigation. First, a simple habitat survey is made. A coat hanger is tossed and the plant community within the coat hanger's perimeter is surveyed. Then there are preliminary activities dealing with temperature differences and wind changes. Many of these same investigations will be done again at the field site. It is important that the students learn the procedures well so that once on the field sites their attention can be directed toward record-taking and observations rather than the logistics of the techniques themselves.

The final section of the unit provides some questions for thought and discussion. We hope they will stimulate you and your students into continuing environmental investigations long beyond the scope of this unit.

MATERIALS

coat hangers
plastic sandwich bags
note paper
pencils
flags or other markers
ozalid paper
scissors
stapler
commercial grade ethyl or isopropyl alcohol
garden trowels, old table knives, or spoons
thread
plastic rulers
150 ft. clothesline or rope
waterproof ink or water-resistant colored tape
insect net (see the back of the book)
3x5 cards
white glue
pill bottles or baby food jars
thumb tacks
thermometers

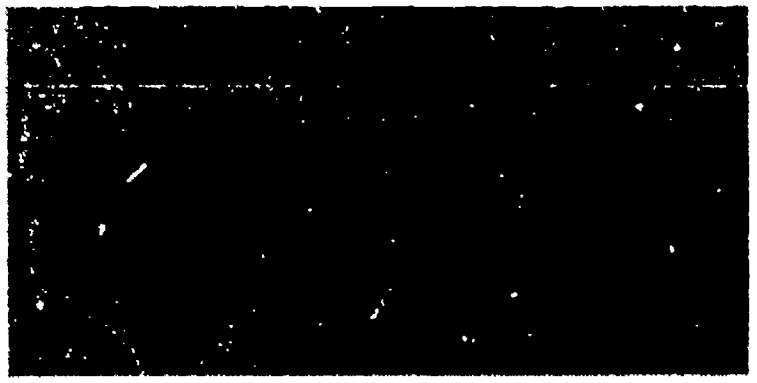
Transect Studies

Pre-Trip Activities

The Pre-Trip Activities included in this section are a practice or dry run. They will be conducted again by the students at the field site. The reason for presenting them in this duplicate fashion is to familiarize the students with the **procedures** and **techniques** before they get involved in the **field site activities.** Once on the field site the students should be concerned primarily with observations, findings, and record-keeping, rather than the logistics of the investigations. The intent of this section is to clear up any confusion that might arise when the investigations are conducted for the first time.

I. Coat Hanger Count

The objectives of the coat hanger count are to familiarize students with a procedure for sampling and comparing plant populations before making a more complex field investigation, and to demonstrate that plant populations differ under different environmental conditions.



Have the class select *three* different locations around the school yard. The class should do this before beginning the pre-activity survey. The three locations should be somewhat different in the general appearance of the plant cover, but great differences are not necessary. Different locations may be found among sodded lawn, natural lawn, lawn along a playground, in a sunny location, in a constantly shady location, in a vacant lot with mowed grass, etc. Each location can cover an area of several square yards. Mark the locations with flags or other markers.

Have the students choose partners, making teams of two students each. Assign approximately equal numbers of student teams to each of the three different locations. In other words, each location will be investigated by several teams. Give each *location* a letter designation: location "A", location "B", location "C." Give each *team* a coat hanger.

Each team will be tossing its coat hanger onto the ground in that team's general study area. The team will next be making a survey of the types of plants lying within the coat hanger area and then counting the numbers of each type. Each team will organize its information on a data sheet. In the back of the book we have provided copies of all the data sheets used in this unit. These can be duplicated and given to the students. Data sheet #1 on page 21 is the one needed for this activity. With the exception of Data Sheet #2, the other sheets, including #1, are to be used in the field trip activities during the on-site investigations.

It is important that the data which the students collect be attached to data sheets like those provided. By using data sheets in this pre-trip activity, the students acquaint themselves with an organizing technique that becomes especially important in the field site activities that follow later in the unit. Specifically, the use of data sheets helps the student organize his information *as he collects it.* This initial organizing of the information is of great value in the post field trip activities where the students have to take the information they have gathered along the transect and reorganize it prior to making generalizations and drawing conclusions.

On those data sheets where it is necessary to attach bags, the bags should be put on before going to the field. You might have each team attach these bags to its own sheets before the day of the field trip. The bags should be attached by stapling or taping one side of the top of a bag at each spot indicated on the data sheets. In this way the bags can be opened easily so that the collected materials can be put in.

The data sheets can then be paper-clipped to pieces of cardboard so that they will be a little easier for the students to work with in the field. By using paper clips the cardboard can be re-used after the project is completed.

You may want to point out to the students ahead of time that the plastic bags will overlap each other once they are attached to the data sheets. After a data sheet has four or five plastic bags attached to it, the entire sheet can look somewhat confusing. This might create a problem, if the data sheets were intended for display purposes. The data sheets, however, are meant primarily to help organize the data so that it can be more readily used in the post field trip activities. The overlapping of the bags does not really impair the effectiveness of the data sheets as organizing tools.

Once on location on the school ground, each team should do the following:

1. Have one member of each team close his eyes and gently toss the coat hanger into the area to be sampled. By closing his eyes while throwing the coat hanger, the exact area of study will be somewhat random, within the context of the general area chosen for study.

2. Have each team take *one* sample of each *different kind* of plant found inside the perimeter of the coat hanger. Students should put each sample in a separate plastic bag on the data sheet. They should try to get the whole plant.

3. Then the teams should count the number of each kind of plant growing within the coat hanger area. Have them write this number on the data sheet beside the bag containing the corresponding sample plant.

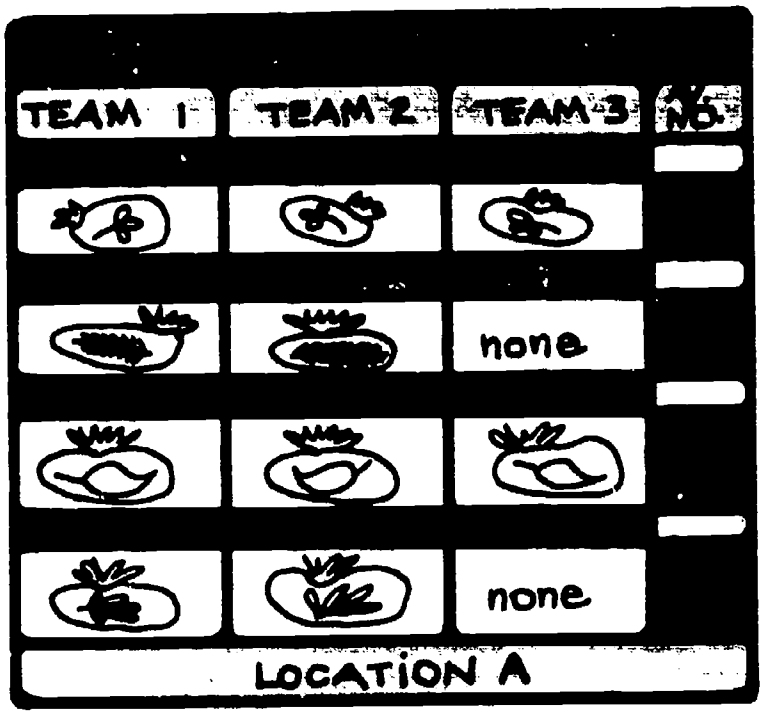
In a thick lawn, grass plants may be very numerous. It is helpful in counting to have a length of string to mark off those plants which have already been counted. When 10 plants of a kind have been counted, the students should move the string to section these off from the rest. When 10 more have been counted the string should be moved again to section off the 20 which have now been counted, and so on until the whole population within the coat hanger has been tallied. (Some students may want to differentiate between different species of grass. This is not necessary for this study. The samples of different grasses can be lumped together if you choose.)

Collection and comparison of data are necessary after the survey. Teams which sample the same location should get together and find out how many different kinds of plants they discovered and if all teams discovered the same kinds. They should compare their samples. This should be done while the sample plants are still fresh. If the samples are detached from the data sheet they should be marked with the location, the number of plants of that kind within the coat hanger, and the names of the teammates.

It is not important to know the names of the plants. But if students think they know the name of a plant, be sure it is a name accepted by the whole class before using it to designate a plant for all the teams. The students might also want to give a plant a temporary name that describes one of its characteristics. If the students decide to assign descriptive names, you should point out that these are names used only for their current study and that the plants have other names which are generally agreed on by the scientific community.

The teams for each location should find the average number of each kind of plant per coat hanger area. That is, they should add the counts for each plant type from all teams in one location, and then divide that sum by the number of teams (even if one or more teams did *not* find that particular plant).

To make comparison between locations easier, a display for each location can be made by removing the bags from the data sheets and tacking the sample bags to a bulletin board. Write the average number (the one computed by the teams from each location) beside the sample bags. A portion of the class display may look like the chart which follows. The exact size will depend on the number of students in your class.



Have the class recall the general characteristics of the three locations that they used for their investi-

gations. Have them discuss any relationships between the general conditions and the data they collected. Can they make any assumptions or draw any conclusions from the information they have gathered? For example, do certain types of plants appear only in moist areas? Dry areas? Shady or sunny areas?

Students may have many ideas to propose about why they got the data they did. Ask the students if it is possible for them to know for sure whether assumptions they might make are true. Ask how they could test to find out. (An investigation to test assumptions may be followed up at this point, but the students will have a better understanding of the kinds of tests that can be made after their visit to the field site.)

Ask the students just how much can be known from the data which they have collected. They should look at the chart alone, without trying to explain how the chart got that way. Actually, the chart tells all that can be known from their data.

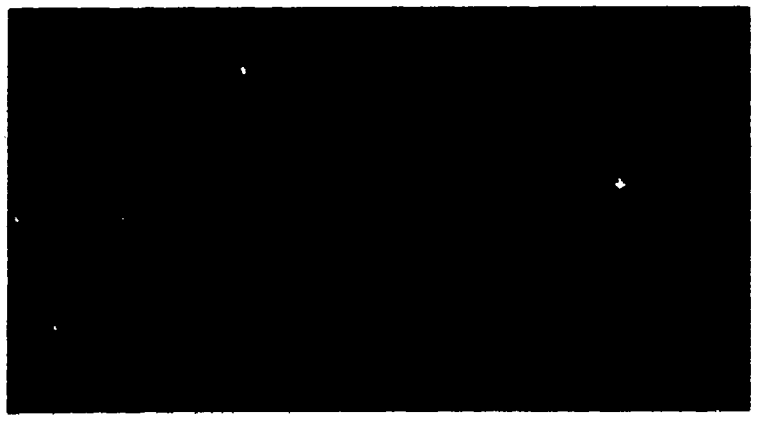
Some possible **types** of conclusions which might be drawn from the preceding chart are:

—Some kinds of plants grow in all three locations.
—One kind of plant may be more abundant in one area of the school ground than another.
—One kind of plant, which is abundant in most areas, does not occur at all in one area.

It is important for students to realize that knowledge and understanding are limited by the amount of measured data collected.

II. Temperature Differences

In the preceding activity, students have had a chance to discover some of the ways plant types can vary according to different physical locations. The objectives of this present activity are to familiarize students with handling a measuring device (in this case a thermometer) and collecting data with it. This section also helps to demonstrate that both soil temperatures and surface temperatures vary under different environmental conditions. The procedures in this section will be used during the field site investigation. Hopefully by that time the techniques will be mastered so that the students can concentrate on record-keeping and observation.



Before the class begins the activity, select a variety of locations around the school yard. Give each location a letter, A, B, C, etc. if the class has done the preceding coat hanger count, be sure to include the three locations from that survey in your selections for temperature readings. Have the students mark each location with a lettered piece of paper pinned to the ground by a pencil or stick.

Locations which show different temperatures could include: a south-facing slope, a north-facing slope, shaded soil, moist soil, dry soil, an area near a building, an area with heavy plant cover, an area with no plant cover, a windy area, an open area, a sheltered area, etc. Include in your group of choices at least some locations which have approximately the same conditions as others in the group. For example, you might want to have two different areas which are both sheltered or two that are near a building.

Have the students break into teams of two or three each. For purposes of identification, give every team a number. (You may want to use the same teams used in the coat hanger activity.) Have each team choose at least three locations to investigate. Teams could rotate to all locations if time permits. Also duplicate and give to each team a copy of data sheet #2 in the back of the book.

Each team will have the following responsibilities at each location:

1. Have one student place the thermometer flat on the ground with the graduations facing upward so they can be read. On its data sheet, have the team record the temperature when it becomes constant. Also record the location letter. This will be the **surface temperature** reading. If the location is in a sunny area, you may want to remind the students not to cast their shadow on the thermometer while the temperature is being registered.

2. Next, at the same spot where the surface temperature was taken, one student should make a slit in the soil by forcing in a trowel or table knife and prying sideways. He should slide the thermometer bulb into the slit to a depth of about three centimeters (1 inch), then close the soil against the thermometer.

3. Make sure the students read the thermometer only after the temperature becomes constant. If necessary, have them scrape away enough soil to take the reading. They should record the soil temperature and the location number. This reading will be designated **soil temperature.**

4. Also have each team note the amount of water in the soil. They should make a rough estimate of the moisture content of the soil: dry—falls apart, sifts between fingers; slightly moist — is moist but does not stick together when squeezed; very moist—water is obvious when squeezed; wet—water drips. Have each team record this information on its note sheet.

5. Each team should also note the general type of soil at the spot where the temperature is taken. Essentially they will want to note if the soil is heavy and clay-like at one extreme or light and sandy at the other, or if it is some consistency in between. Also have them note the color of the soil. This information should also be recorded on the team's note sheet.

6. Students should also observe the characteristics of the location and write a few words to describe the location (is it in open sunlight or shade; is it on a slope; is the plant cover heavy or sparse?) The students can make a note of anything which they think might influence the temperature.

Following is a portion of a data sheet containing information similar to that which one team might find. A full size data sheet is included in the back of the book so that you may duplicate it for the students' use during this activity (see page 22).

	LOC. A	LOC. B
Surface temp.	71°	67°
Soil temp.	70°	65°
Time	10:00	10:10
Soil description	MOIST, LIGHT SANDY	MOIST SANDY
General location	SLOPE OF HILL, SUN LIGHT	PARTIAL SHADE NEAR TREE

Collect and compare the data by recording the reports of each team on a large chart. Make the chart from paper or put it on the chalkboard. It could look like this:

	Surf. Temp.	Soil Temp.	Soil Cond.
1	71°	70°	MOIST
2	73°	71°	MOIST
3	71°	69°	MOIST
4	72°	70°	MOIST
5	72°	70°	MOIST
6	73°	71°	DRY
7	73°	70°	MOIST
Average Temp.	72.1	70.1	

Have the members of each team enter their temperature measurements and their estimate of soil moisture. Have them keep their observations of the characteristics of the locations for later discussion.

The students should average the surface temperatures as well as the soil temperatures taken by each team at each location. You may want to discuss the value of averaging the results of several measurements to eliminate extreme differences which could be accidental.

Have the class discuss any relationships between temperature and soil moisture which may be evident. Discuss relationships between temperatures and other location characteristics. (For example, exposure, plant cover, obstructions, etc.) If the coat hanger count was made, discuss the possible relationships of temperature to this previous survey. Students should not try to come to any definite conclusions at this time. Conclusions will be more apparent after gathering further data during the field site activities.

III. Measuring the Wind*

A. Wind Strength

ASK THE STUDENTS:

Where are the strongest winds? Where are the weakest winds? Is the wind different at different times of the day in the same location? Is there more wind two feet above the ground than six inches above the ground?

*For more extensive work on wind and wind-measuring instruments, see *WIND*, another unit in this series.

In order to answer the above questions, it will be necessary for the students to realize that wind speeds are related to the physical surroundings of an area. Measuring actual wind speeds in several areas will enable the students to see some of these relationships.

Give each student a ruler and a piece of thread about 10 inches long. One end of the thread should be tied to one end of the ruler. Place the ruler on the ground vertically, with the knot nearest the top. When the wind blows, the thread will make an angle with the ruler. This angle will vary with the strength of the wind. Be sure the ruler is held perpendicular to the ground. If the thread is curly and doesn't hang straight down, it can be rubbed out straight with a small amount of light weight oil such as cooking or lubricating oil.

Give each student a map of the school grounds. The map should show each of about thirty wind measurement locations that have been marked on the school grounds. Have each student take three pieces of paper, his map, a pencil and his wind measuring device outside. On the three sheets of paper, have each student sketch the angle the thread makes on his wind gauge at three of the marked locations. (By having each student take readings at three locations, the class will have some checks on the information they gather. For each wind velocity drawing, have the students record and describe the location. For example, "Location A—under a bush," "Location B—in an open field," "Location C—beside a building.")

B. Wind Direction

On their individual maps, have the students indicate the way the wind is blowing at each of their three locations chosen for measuring wind velocity by placing an arrow on their maps pointing in the appropriate direction.

C. Summarizing the Data

After each student has recorded the velocity and direction of the wind for his three locations, return to the classroom and compare data. Group similar wind angles in the same pile. Then compare the locations that have the same wind velocity. The students will probably discover that the areas with the least wind have the most obstructions and vice versa.

Have the students transfer the wind direction data they have gathered onto a large classroom map of the area they have investigated. If some of the students have recorded different directions for the same locations, they may want to record all of the individual findings. Can the class figure out some possible explanations for the differences in wind direction between one part of the school yard and another? How might they explain two different directions for the same part?

IV. Collecting Insects

The aim of this pre-trip activity is: (1) to familiarize students with collecting invertebrates for a comparative study involving kinds and number, and (2) to encourage awareness that populations of animals differ in different environments.

Ask each student to bring a pill bottle or small baby food jar to school. Have each wrap tape around his jar to prevent shattering in case the jar is broken or damaged. Each student will use his container as a killing jar.

Pour about ½ inch of alcohol in each student's jar and seal it tightly.

A. Collecting

Have each student catch five different "bugs." They may catch them in any manner they choose. They might want to catch them at home or around the school. They need not collect more than one of each of five different kinds. Collecting only what is needed is good conservation practice.

Have the students kill the "bugs" by putting them into the killing jars and quickly replacing the covers. Leave the jars sealed for at least thirty minutes. (If someone has caught a bee or hornet in a net or other jar, chill it in the refrigerator for a half hour before transferring it to the killing jar. The cold slows invertebrate animals, making stinging and biting insects safer to handle.)

Each student should keep a record of where each of the insects he has caught was found and a rough description of what the place was like. For example: "The black shiny 'bug' was in the dirt in our garden," or, "The ant was crawling on the sidewalk," or, "The 'bug' was sitting on a tree leaf."

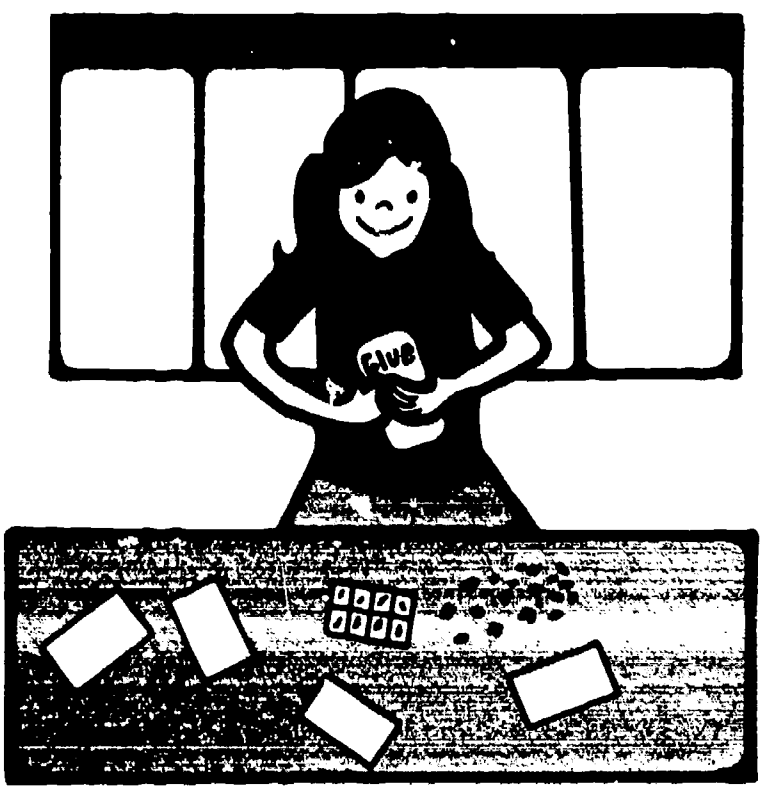
B. Preparing for display

After about a half hour, remove the "bugs" from the killing jar and lay them on paper toweling to dry for five or ten minutes. Note: the wings of butterflies and moths will be damaged by this procedure, but this is not critical to the activity because the aim here is to study the insects rather than make an attractive display.

Mounting the bugs

After the alcohol has dried, give each student several 3x5 cards divided into four or six areas by lines, and some white glue.

Have each student mount his "bugs" in the following way: Put a drop of glue on each square of a card and place a "bug" on top of each drop, letting each one settle into the glue. Allow the cards to set for ½ hour or until the next day to be sure the glue has hardened. (The white glue turns clear when dry.)



C. Studying the "bugs"

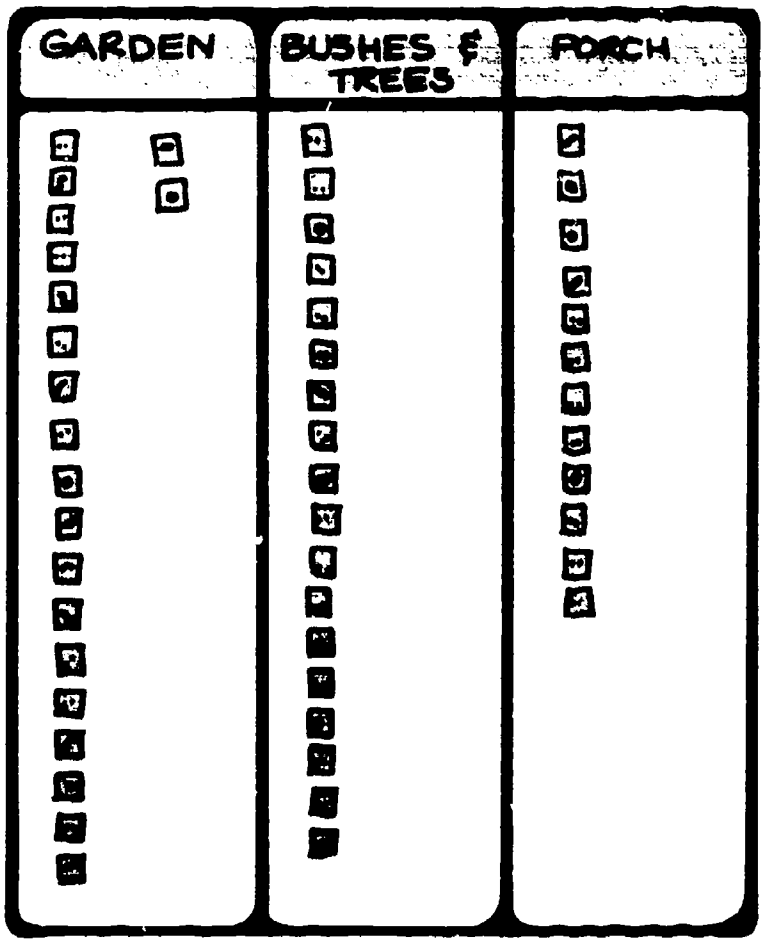
Allow the students some time to compare their collections among themselves and to categorize the collections.

Divide a bulletin board or wall chart into four or five areas.

Have the students decide what major kinds of places the insects they collected came from. They should base their decisions on the evidence provided by the records they kept on where they caught their insects.

Label the areas of the bulletin board accordingly: e.g., sidewalks, lawn, porches and garages, garden dirt, on trees and bushes, etc.

The students should then separate their mounted bugs by cutting the mounting cards along the division lines. Each student may wish to initial each of his cards so that he can identify his contributions to the class display and write on each card where the insect was found. When the bugs are separated, each student will tack each of his mounted insects to the most appropriate area on the bulletin board, according to the information from his record. Thumb tacks should be used so that the insects can be moved around easily.



The main goals of making this first chart is to help the student see the number and variety of insects found in each area.

Discuss the display of bugs. Have the students look for any patterns they might see in the display.

ASK THE STUDENTS:

In the display do you find more than one of a particular kind of bug, and if so, where? (At this point have the students rearrange all the bugs so that the same kinds are in individual rows in each location area.) A final display of insects might look something like this:

GARDEN	BUSHES & TREES	PORCH
ANTS	ANTS	ANTS
WORMS	WORMS	WORMS
SPIDERS	SPIDERS	SPIDERS
HOPPING BUG	HOPPING BUG	HOPPING BUG

Where were the most of each kind found? How many were there of each kind in each area? Were there some particular kinds of bugs which were found in more than one location? Were some particular kinds found in all locations? Are there other patterns which show themselves?

Have the students predict where a certain kind of bug would most likely be found if they hunted for it again. Be sure that students use only the information from the display as evidence for their predictions.

Students may also be interested in finding other ways of ordering the bugs. For example, the insects might be ordered according to structure, number of wings, color, size, etc.

V. Preparing Materials for Field Site Activities

A. Transect Rope

Use a clothesline rope that has about ten feet of length for every two students in your class. You will probably need a piece of rope about 150 feet long (60 meters). Give a group of students waterproof ink or water-resistant colored tape to mark the rope. Have them mark the rope every ten feet (4 meters). Then have them attach a tag at each of these marks and label the tags #1, #2, #3 etc. Once on the field site, the rope will be laid out across the area to be investigated. Each point marked with a tag will be a station at which two students will carry out their transect investigations. The actual field investigations will be explained and outlined in the Field Site section.

B. Ozalid Paper

Ozalid paper is used to measure light intensity. (See materials list on page 11 for sources.) The paper is yellow on one side. This yellow color fades as it is exposed to light. Sheets laid on top of each other will fade in succession—the top sheet fading first. When a stack of the paper is exposed to the sun for a specific length of time, the number of faded sheets becomes a measure of the intensity of light in that specific location.

Cut and staple together stacks of about ten pieces of ozalid paper (each piece 1"x1"). Keep the yellow side up. The preparation must be done in very dim light and the stacks must be kept in the dark while transporting them to the field site. There should be one stack for each team. The teams should keep their stacks of ozalid paper in light-tight boxes until they expose them on their transect.

Selecting the Field Investigation Site

As a final preparation before the actual day of the field trip, you will want to check on the suitability of a local area where your students will conduct their transect studies. If you live near rural areas, you might get permission from a landowner to use a section of his property for the studies. It would be best if the area you choose has a variety of vegetation and environmental conditions. The most desirable location for the studies is across an area of change. For example, from a wet area to a dry area, from a low area to a high area, from an open field into a woodlot, or from a sunny area to one constantly shaded would each make a good area to investigate. If it is not possible to locate your field trip in an area of change, the transect will still be a worthwhile tool for handling an examination of a somewhat homogeneous area like an open field.

You will probably want to determine several good possible places for locating the transect rope at the field site. On the day of the field trip, you may want to let the students decide which one of the suitable areas they would like to have the class investigate.

Field Site Activities

Up to this point the students have been practicing some of the techniques which they will be using at the field site. They should now be ready to begin the actual on-site investigations. The introduction to this unit describes what a transect is. You may want to review this explanation briefly at this time.

The objectives of the field investigations are (1) to have the students obtain data from measurements for later use in discovery of natural relationships, (2) to help the students gain direct experience with using tools and techniques in ecological study and, (3) to help the students gain direct exposure to a relatively undisturbed natural area.

I. Organizing the Materials

One of the best ways to distribute the materials the teams will be needing for their investigations is to make up an equipment kit for each team. Each kit could include an insect net, a spoon or garden trowel, a thermometer, ozalid paper packets (in light-tight containers), a wire ring for sampling, a small jar with lid, and a set of data sheets (#1, #3, #4, #5, #6, #7, #8).

Except for the data sheets, these materials can be put in individual paper sacks or cloth bags. The bags can be labeled with the same designation as the station along the transect rope. Once on the field site, each team can be given a kit. Each team can then go to the station on the transect rope corresponding to the number on its kit. This is a convenient way to assign the teams to the various stations.

The data sheets can be distributed separately. Before going to the field site, you will prabably want to have the students attach the plastic bags to those sheets on which the bags are needed. The students can also clip the sheets to cardboard prior to going to the field.

II. Schedule

The following schedule was set up for an on-site investigation. It is a suggestion only. Others would work also, depending on your individual situation.

The particular time sequence allows for adequate completion of the activities included in the field trip

description which follows. The schedule includes time to organize data and prepare charts while on the field site, but in order for the student to do this organizing at the field site, there will need to be a shelter and tables available. If the on-site organizing is not convenient because of lack of facilities, you can take the students back to the school immediately following the "Afternoon Studies" section. They can make their charts and discuss their results in class.

10:00-10:15 Arrival (rest stop and assembling)
10:15-10:30 Orientation, instructions, equipment handout.
10:30-11:30 Morning studies (light intensity, temperature, moisture, plant samples.)
11:30-12:00 Lunch
12:00- 1:00 Afternoon studies (insect samples, temperature, soil, wind)
1:00- 1:30 Organization of data on chart (included in post-trip activities, but can be done in the field if weather and facilities permit).
1:30- 1:45 Discussion of data
1:45- 2:00 Cleanup, rest stop, loading

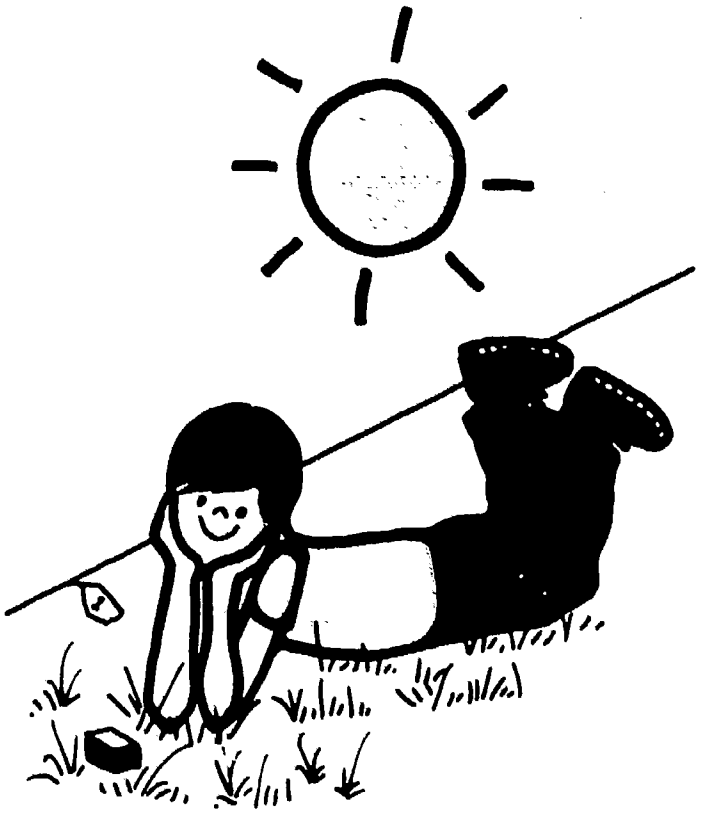
III. The Transect Investigations

When the students arrive at the field site, you might want to give them a few moments to look over the possible study areas. Once the class has decided on the particular area they would like to investigate, extend the rope across that area in a straight line. Distribute the equipment kits. Have each team go to its assigned station along the rope. The teams are now ready to begin the on-site transect investigations.

A. Light Intensity

The placing of the ozalid paper for this activity should be the *first* concern of the day. (Refer to page 10 for an explanation of the function of ozalid paper.) As suggested in the preliminary activities, the packets of ozalid paper should be transported to the field trip area in light-tight boxes. When a team receives its packet the students should try to keep it from the light as much as possible until they put it in place at their transect station. These packets should be the last items passed out, but the *first* used. To allow adequate exposure time, the packets should remain at the station until the study is concluded. Perhaps a whistle could be used to signal it is time to collect the packets and count the faded pages. A **two-hour** exposure is about right on a sunny day.

To place the packets each team may select some *typical* location near its station, and lay the packet on the ground with the yellow side facing up and horizontal to the ground. The students should make sure they don't shade the paper with these objects.



All the teams should count the faded pages of its packet at about the same time. The sun shining on the packet will have faded the yellow from the first page, then the second, etc. A team may find several pages completely faded and one page where the yellow is only partially faded. Fractions other than ½ sheet and ¼ sheet will be too difficult to differentiate, so ask the students to record only a page that is completely faded, half faded, or quarter faded. Record this information on Data Sheet #7.

B. Temperature (morning and afternoon)

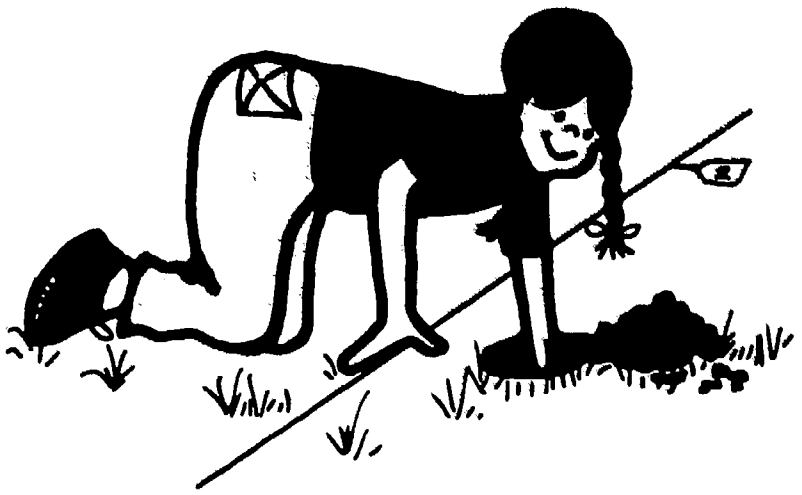
Each team should have one thermometer and a spoon or garden trowel. They should select a spot on their section of the transect to take the surface, soil and sub-soil temperatures. The procedure is similar to that in the Pre-Trip Activities. The temperature should be taken in the morning at the start of the activities and in the afternoon at the conclusion and recorded on Data Sheets #3 and #5.

The **surface temperature** is taken by laying the thermometer on the ground, bulb up. Students should wait until the fluid stops moving and then record the temperature in the appropriate section of the data sheet.

The **soil temperature** is taken by first digging the handle of the spoon into the soil and prying sideways to make room for the thermometer. The thermometer is then inserted into the hole about 3 cm. and the soil pushed back around it.

Students should wait until the thermometer has had time to adjust (approximately three minutes). Then they should scrape enough soil away to read the thermometer while it is still in place. Have them record the temperature in the appropriate section of the data sheet.

The **sub-soil temperature** is taken by digging a hole deep enough to reach half way to the student's elbow. The temperature is then taken at the bottom of the hole in a manner similar to the way the soil temperature was taken. Have students record this temperature in the appropriate section of the data sheet. The students will probably have to remove the thermometer from the hole in order to be able to read the temperature. Point out that they will want to take a temperature reading as soon as the thermometer is removed from the ground.



C. Moisture

The directions for the moisture determination are included on the data sheet in the back of the book, page 26. Each team determines the moisture for a typical spot near their station on the transect. This information is recorded on the data sheet.

D. Plants

1. Surface cover plants
   Each team should place its wire ring or coat hanger so that it touches or crosses the transect rope, close to its station. The students should then collect one sample of each type of plant found within the wire, as they did in the pre-field activities. Have them place each plant in a separate bag in its appropriate spot on the data sheet. For this activity you may use the same data sheet used in the pre-trip activities (see Data Sheet #1, page 21.) When each team has located all the different types of plants within its wire area, each team should then count the number of each type. This number is then recorded on the data sheet next to the bag containing that sample plant.
2. Shrubs, bushes, etc.
   Each team should remove one leaf or twig from each type of plant which is higher than their knees but lower than their heads. These plants must overhang their section of the transect. The exact size of a team's transect section is arbitrary, although all the teams should be studying the same amount of ground. One good way to define the limits of the area a team is to study would be to give each team a piece of string five feet long and have them use this as a radius around their station. Then when a team finds a plant "higher than their knees" but is not certain if the plant is within its study area, that team can swing an arc with its string, using its station on the transect rope as the center for the string, to determine if the plant in question is within the limits of its study area. The sample is placed in the appropriate bag on the data sheet. Write the number of plants of that type beside the bag containing the sample. For example, a bush would be called one plant. Use Data Sheet #4, page 24.

3. Trees and tall bushes
   Each team should remove one leaf or twig from each type of tree or bush that overhangs its section of the transect and is taller than a student's head. The sample should be placed in the appropriate bag on the data sheet. They should write the number of plants of that type beside the bag containing the sample. Use Data Sheet #4, page 24.

E. Insects

Provide each team with two plastic bags containing ⅛ cup alcohol each.

1. Sweeping for insects on plants
   Have the teams sweep their section of the transect with an insect net (see the back of the book,

page 28, for instructions on making a net). The area each team sweeps should be along the transect line and should be at most about ten feet altogether. A good way to do this would be to have each team sweep over a five foot distance on either side of its station marker, along the transect rope.

To "sweep", the students should extend the insect net with the opening sideways. They should swing the net across in front of their body, turn the net and swing it back the other way in a figure eight. At the low loops of the figure eight the net should brush down the vegetation. The students should take a few practice swings so they don't hit the ground too hard or swing too high. When they finish sweeping with ten swings, they should grab the neck of the net a few inches from the bottom and close it off so no insects can escape. The section of the net containing the insects is then inserted into the bag containing alcohol. Have the students wet the net with alcohol and hold the net and killing bag in this fashion until they count to 200. The insects can now be removed and placed in the appropriate bag attached to the data sheet. Have the students add a small amount of alcohol to the data sheet bag.

2. Searching for ground insects
   Have each team place its wire ring or hanger on the ground at the team's station. Part of the ring should lie under the rope. They may now carefully search for insects in the area enclosed by the ring. As they find insects, the students should drop them into the killing bag. Have them leave the insects in the killing bag for several minutes. Remove the insects and place them in the appropriate data sheet bag with a small amount of alcohol.

   After the data collecting activities are completed, have the students prepare the insects using the procedure outlined in the pre-trip activities, page 9. You will probably want them to do this back in the classroom, unless you have the facilities to carry out the post-trip activities on the field site.

F. Soil

Using the spoon or trowel, have each team clean away the surface material from an area of ground about five inches in diameter. Then have each team collect a handful of soil from the surface to a depth of about one inch and put the soil in the appropriate bag on the data sheet. Have each team indicate on the data sheet the moisture content of the soil.

Students should then dig down to a depth reaching about half way to their elbow (20 cm.) and take a second sample. They should place this sample in the appropriate bag on the data sheet (the hole dug for the sub-soil temperature reading can be used), and indicate moisture content and soil type. Be sure the hole is refilled at the end of the study.

G. Wind

The wind reading is taken and recorded in the same manner as was done in the preliminary wind activity (see page 7).

The recording is made on the data sheet. The wind may vary as the students check at different levels above the ground. The data sheet has places for recording wind at three different levels.

Post-Trip Activities

I. Bringing All the Information Together

Studying the great quantity of collected data can be a frustrating procedure. Organization is the key to coming up with some meaningful and valid conclusions to the study. If organization is left at the class discussion level, there are several pitfalls which may occur.

One of these pitfalls could be to "steer" the class into "discovering" certain relationships. For example, questions could be too leading, such as "Might the great amount of bushes at this transect station account for the slight wind?"

Another pitfall the students might encounter is finding certain relationships and calling them valid

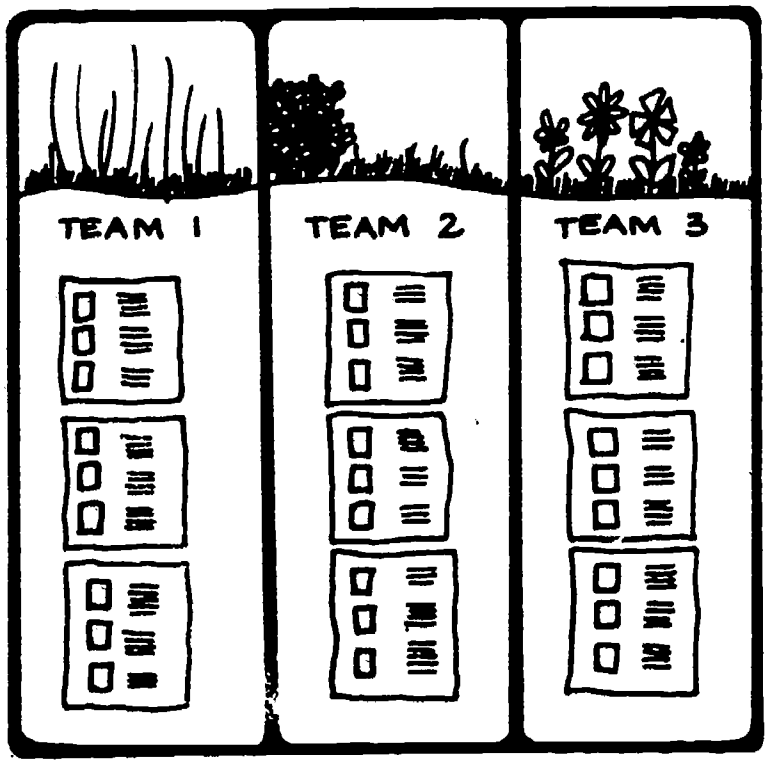
without supporting this conclusion with other data they have collected. For example, one type of plant exists only in a section which has the highest moisture content. The conclusion is drawn that this plant exists only where there is high moisture. However, there are other factors which must be considered. Has the light intensity been considered? The temperature?

A final pitfall is that class discussion technique does not stimulate every student to think and contribute his ideas.

Here are some suggestions to help avoid these pitfalls:

A. Make a display chart—This can be constructed by spreading rolled paper across the top of a bulletin board in the classroom. The lengthwise direction of the paper can represent the transect line. At regular intervals (about one to three feet) each team can designate its own station number. At its station number on the paper, the members of each team can sketch the type of vegetation they found at their area of investigation along the transect. This drawing might include trees, bushes, etc.

Below each station number on the transect chart each team can attach its data sheets. The illustration below shows what a portion of the chart might look like.



B. Hold a brief class discussion to look at the display chart as a whole.

ASK THE STUDENTS:

Are all the transect stations alike? Which transect stations are similar? Which transect stations are very different?

C. As a next step in understanding the data they have collected, have the students prepare class graphs of plants and animals, wind, temperature, etc. Beginning on page 17 are samples of some of the types of graphs the students might develop. Similarities and differences between transect stations will be made more apparent by such a display. Graphs will help the students study the factors causing similarities and dissimilarities.

D. Account for the results of the class graphs.

1. Organize the class into groups, with each group made up of two teams (four students).
2. Have each group prepare a list of suggested reasons for the similarities and dissimilarities between stations found on the class graphs (section C above).
3. Combine these lists on the board. This composite list will probably refer to factors such as light intensity, temperature, etc.
4. Have each group choose one or two of the plants or insects found on the charts. Ask them to study the distribution of these plants or insects from the information that has been gathered along the transect. What factors from the list do they think might have helped determine the distribution?
5. Each group should prepare a statement complete with data supporting the conclusions drawn from the class collection of data. Encourage the students to make graphs and visual displays as often as possible to support their conclusions. Many teams will make only intuitive judgments. Encourage them, however, to see the supportive value in using the data from the display to validate their opinions.

Following are two examples of results which may occur within the same class. The first is an extremely simple statement of conclusion. The second is very complete.

1. "We found our flying insect at stations 7 and 8 (Graph #4). There was no wind recorded for stations 7 and 8 (Graph #7). This insect probably likes very still air."
2. "A three-leafed plant was found only at station 3, 4, and 6 (Graph 2A). We looked at the light intensity, temperatures, soil, wind, and moisture on the large display and, based on these graphs, we decided that the distribution of this plant probably depends mainly on moisture and light intensity and soil temperature. The soil type could not be graphed. However, the soil type was the same throughout the transect so we did not consider this as a determining factor influencing life along the transect.

"We noticed that the combination of slightly

moist soil, high light intensity and high soil temperature (Graphs #6, #5, and #9). are factors that remained constant for stations 3, 4, and 6 where the plant was found. We suspect that none of these factors is the lone determinant. We cannot explain why station 5 does not contain this plant as it has slightly moist soil and high light intensity and high soil temperature. Perhaps the sampling missed this plant at station 5 even though it was really growing there. Graphs #1 and #2A show which stations our plant was growing in."

II. Discussion Questions

Often a group will need a question to get them started. Following is a list of suggested questions, one or two of which you may need to use to start a group thinking. You may wish to read through the questions to orient yourself to the great number of possible investigations the groups might pursue. It is not intended that you use all these suggestions.

A. Temperature

Which of the three temperatures, surface, soil (3 cm. down), sub-soil (20 cm. down) is generally the warmest?

Are there any stations at which the *three* temperatures (surface, soil, sub-soil) are almost the same? Looking along the transect, where do the surface, soil and sub-soil temperatures vary the most between the stations of the transect?

Are there any significant changes in temperature from one station to the next?

Is there any *progressive* change in temperature over three or more transect stations?

By looking at the collected data, can temperature be considered as a determinant of numbers and types of life along the transect?

Can the students find some patterns of temperature along the transect? Can they find patterns in numbers of plants and insects? Do they find patterns in the types of plants and insects?

Is there a certain ground bug found only at the warmest transect stations?

Is there a certain type of plant found only at the coolest transect stations?

Do the numbers of a certain type of plant or animal seem to change with temperature?

Make sure the students do not draw the false conclusion that temperature is the lone determinant. Moisture, light intensity, etc., may also affect the distribution of life. In fact, the temperature itself is a result of many factors such as moisture and light intensity.

B. Light Intensity

As with the temperature readings, guide the students toward a discussion of whether the light intensity at different stations varied as some other factor varied. Were there waist-high or overhead plants present on some transect stations and not on others? Does there seem to be any relationship between light intensity and heights of plants?

C. Soil

Examine the display for different types of soil. Can the class think of any reasons why different types might exist?

Can they find a progression from one type of soil to another?

Does the soil or sub-soil temperature vary as much as the surface temperature?

Do the types of vegetation change with the soil?

Is the surface soil different from the sub-surface soil in some cases? Is it the same in some cases?

Can the class decide anything about the depth of the surface soil? If the depth seems to change along the transect can they think of any reasons for this happening?

Does any other factor change when the soil changes? Is one dependent upon another? Is there any way to prove this?

D. Wind

Does the force of the wind vary much along the transect?

Are there physical obstructions or land characteristics which change where the wind velocity changes along the transect?

Does there seem to be a relationship between amount of wind and the numbers or kinds of flying insects?

Is there a relationship between amount of wind and surface temperature?

Is there a relationship between amount of wind and moisture?

E. Moisture

Is there a possible relationship between moisture and a plant type or numbers of a plant type?

Between moisture and presence of a ground insect type or numbers of an insect type?

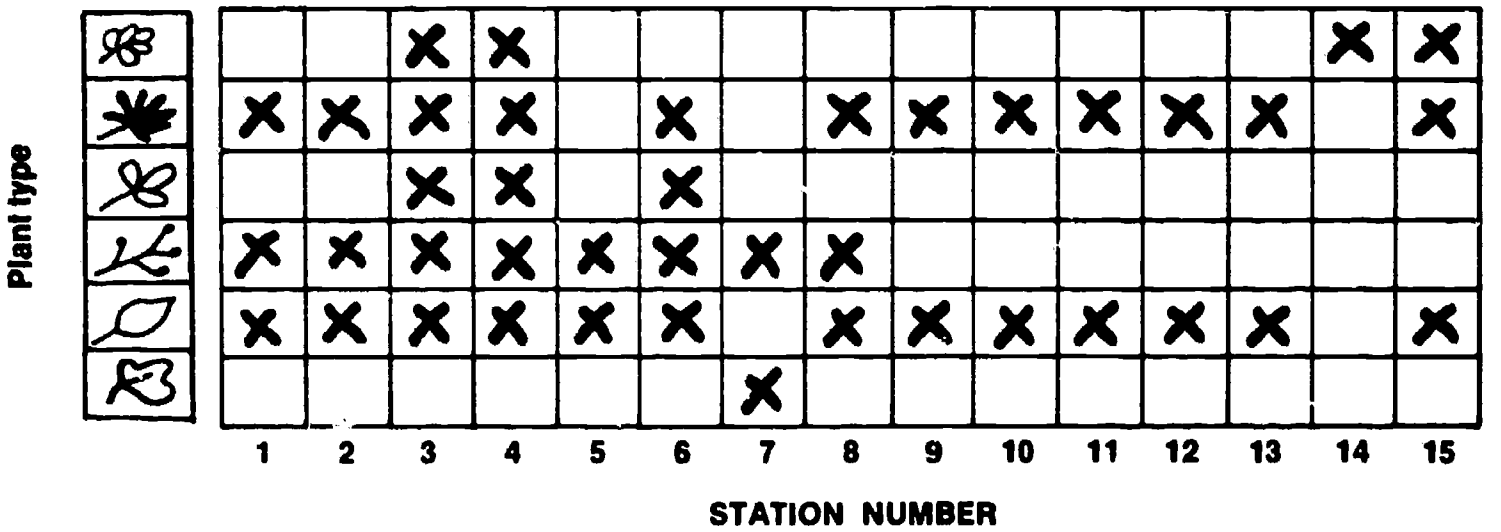
Why are there different amounts of moisture? Is there a possible relationship between moisture and light intensity? Between temperature and moisture?

With questions like the preceding you can encourage students to find relationships or patterns which occur in the natural environment along the transect. Often these relationships and patterns are far more important to understanding the life along the transect than the simple presence or absence of certain kinds of animals or plants. It is through an understanding of the many relationships between living things and physical factors that we can come to have a proper understanding and respect for an environment.

PLANT TYPES

Graph #1

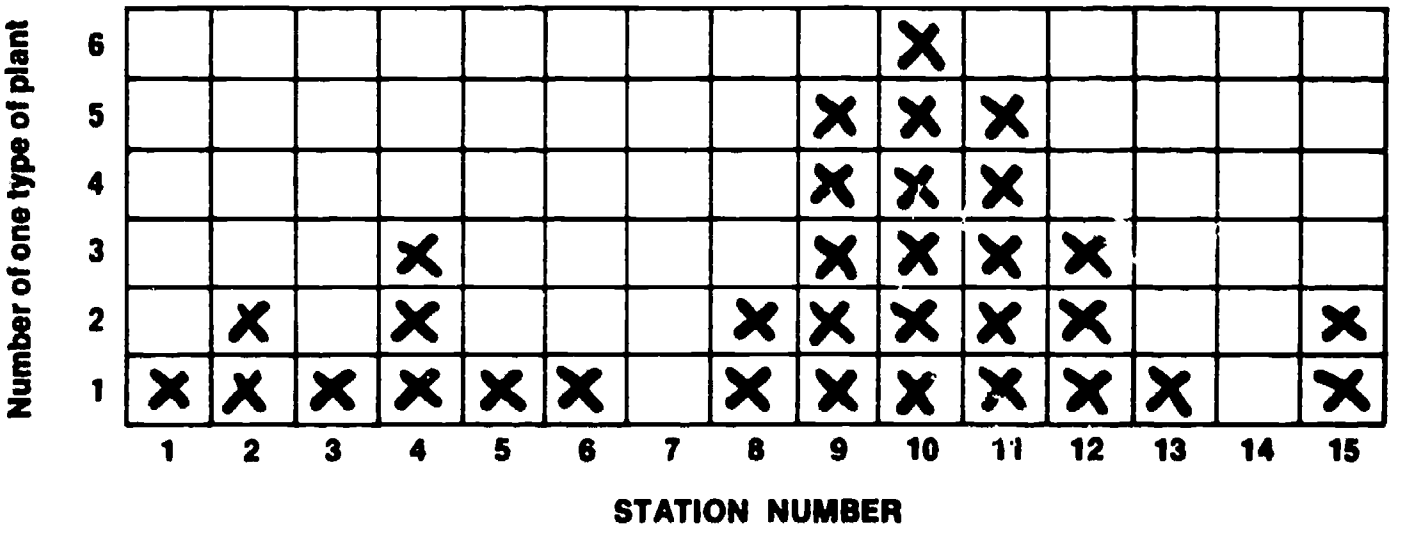
Graph plant types against transect stations, using the plants found within the wire rings.



NUMBERS OF ONE TYPE OF PLANT

Graph #2

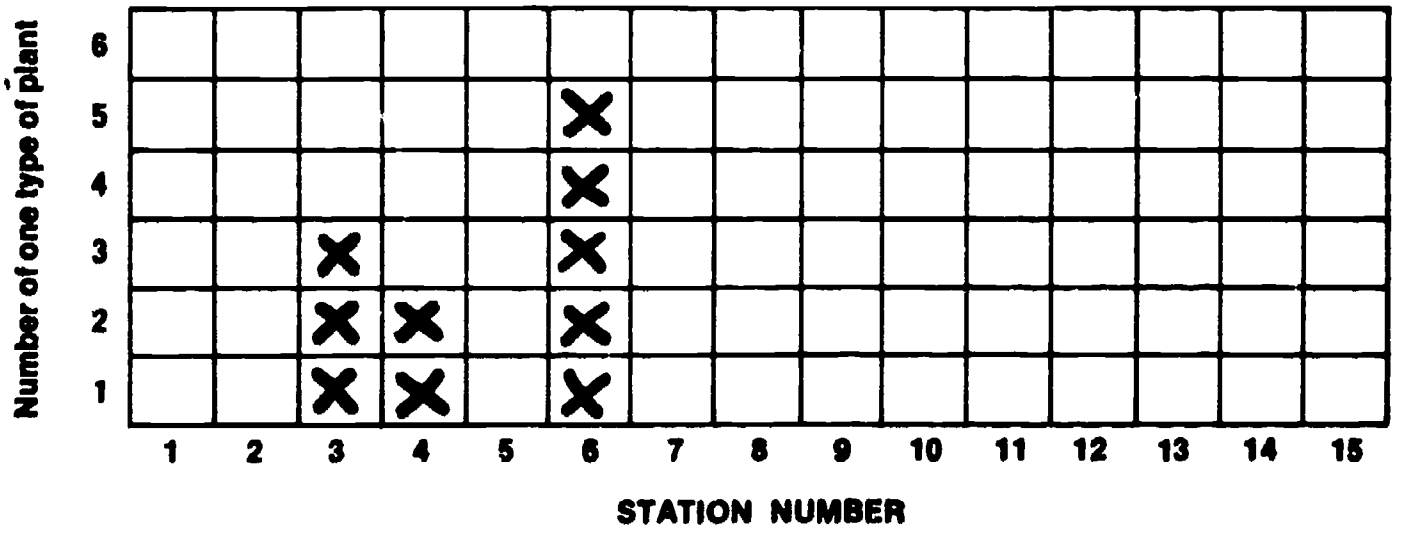
Graph numbers of a plant type against transect stations, again using the plants found within the wire ring. (Make several graphs for various types of plants.)



NUMBERS OF ONE TYPE OF PLANT

Graph #2 A

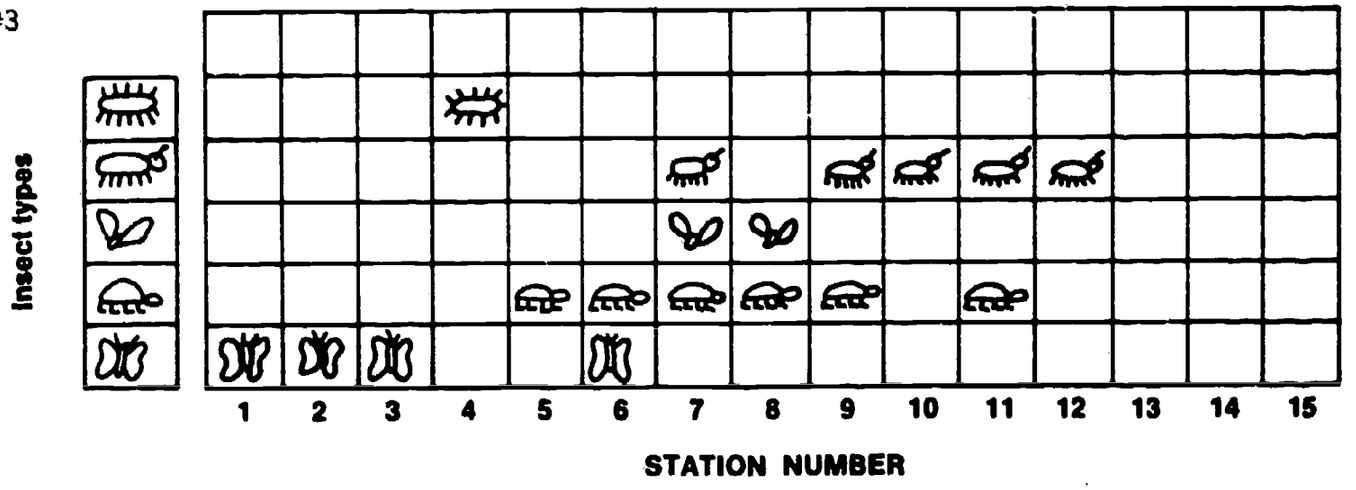
Numbers of a type against transect stations



INSECT TYPES

Graph #3

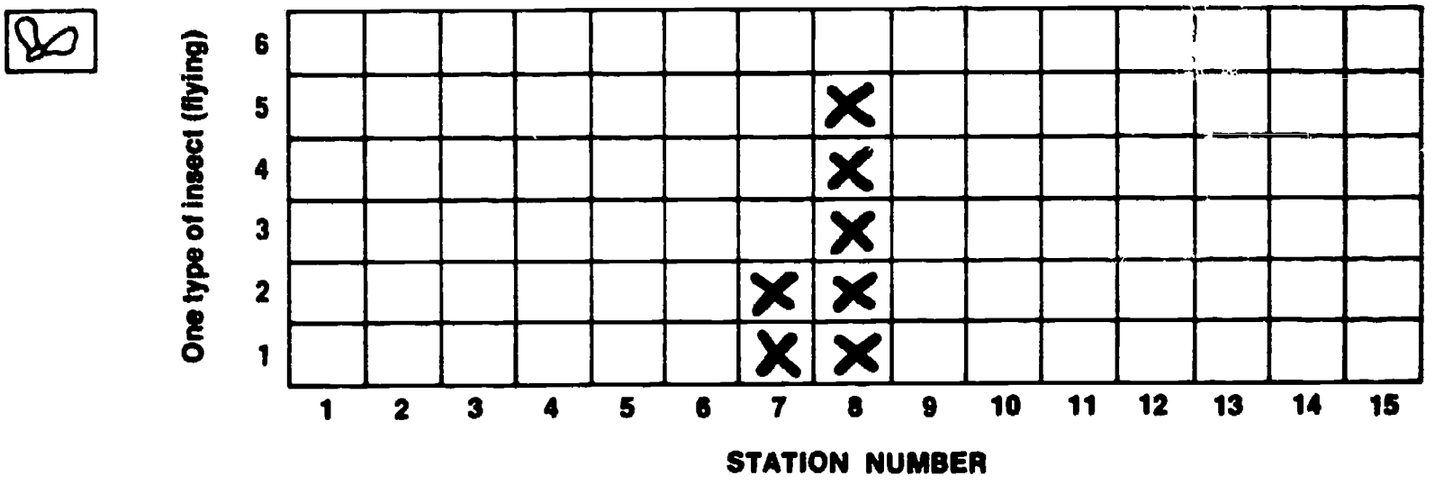
Graph insect types against transect stations.



NUMBERS OF ONE TYPE OF INSECT

Graph #4

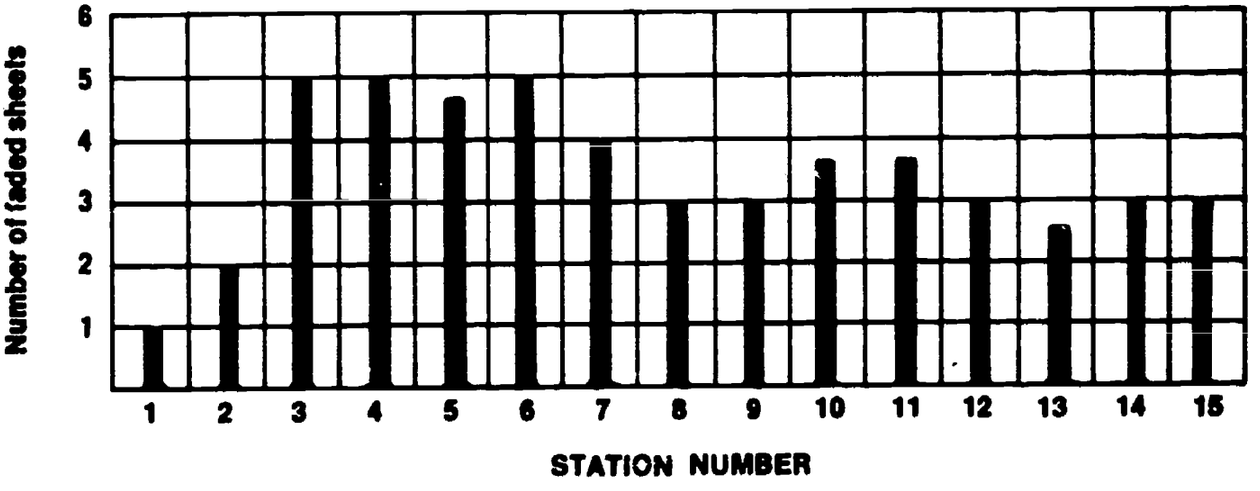
Graph numbers of an insect type against transect stations (make several graphs for various types of insects).



LIGHT INTENSITY

Graph #5

Graph number of faded sheets of ozalid paper against the transect stations.



5 Wet

4 Very moist

3 Moist

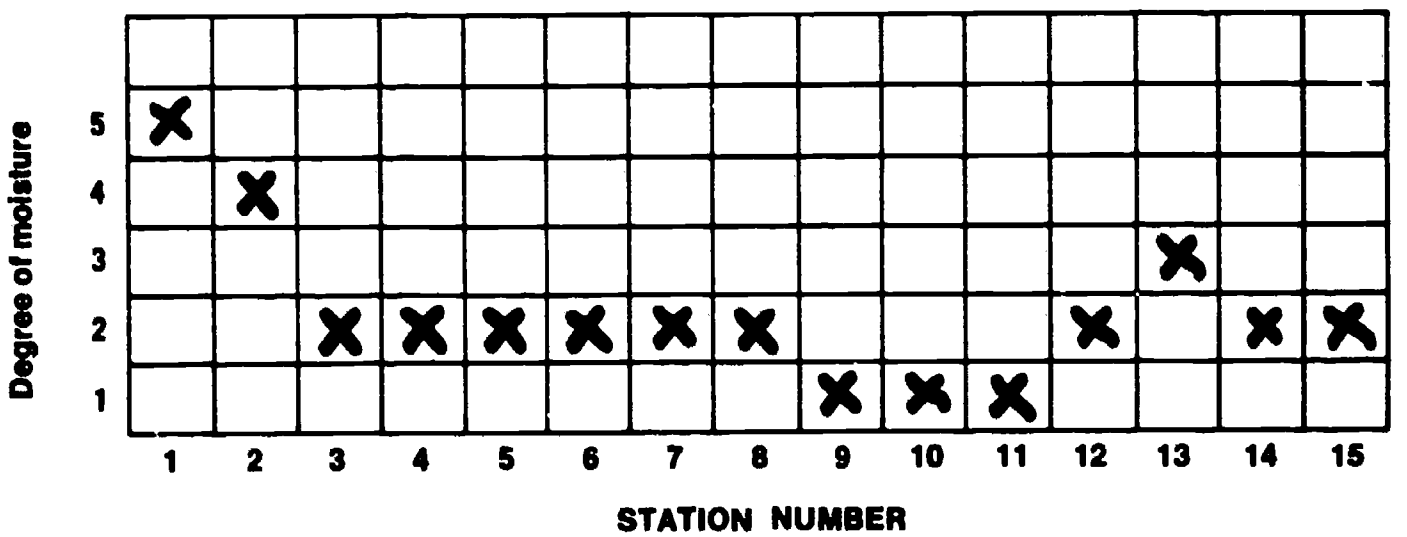
2 Slightly moist

1 Dry

MOISTURE

Graph #6

Graph degree of moisture in soil against transect stations.



5 Big wind .....

4 Light wind .....

3 Breeze .....

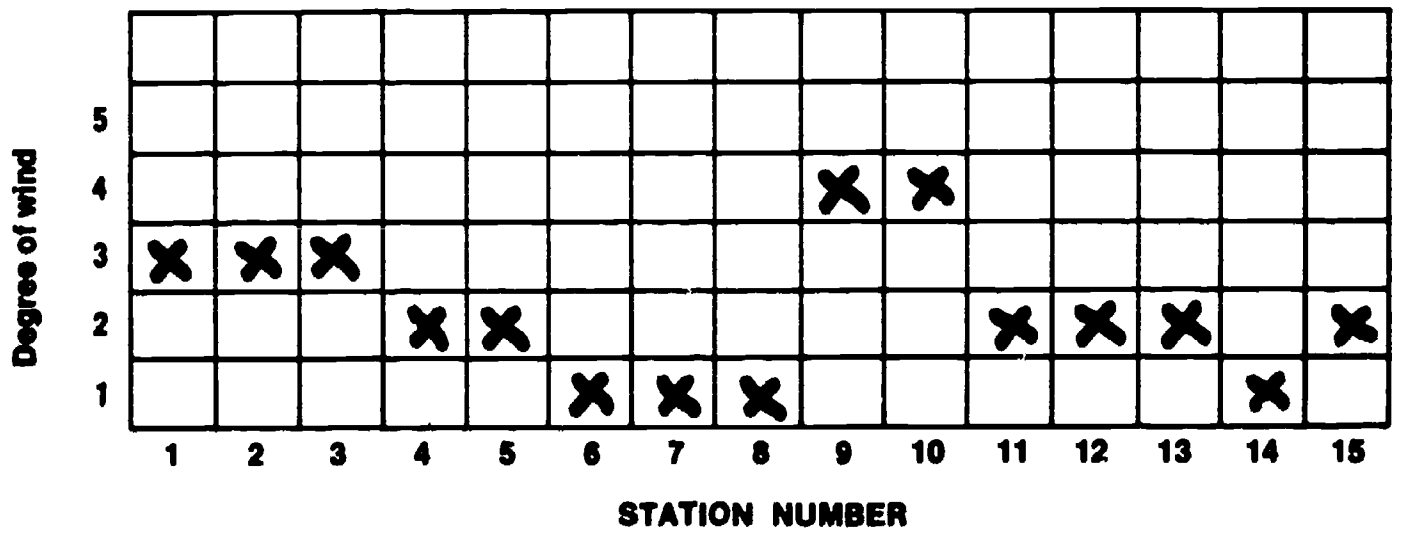
2 Little Breeze ..

1 No wind .....

WIND

Graph #7

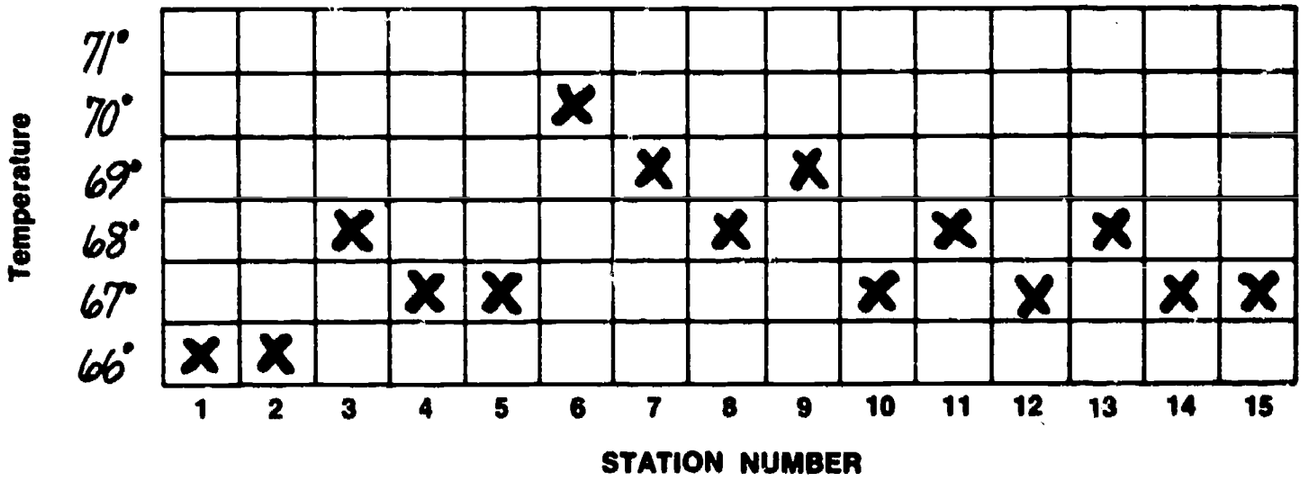
Graph wind velocity against transect stations.



SURFACE TEMPERATURE

Graph surface temperature against transect stations.

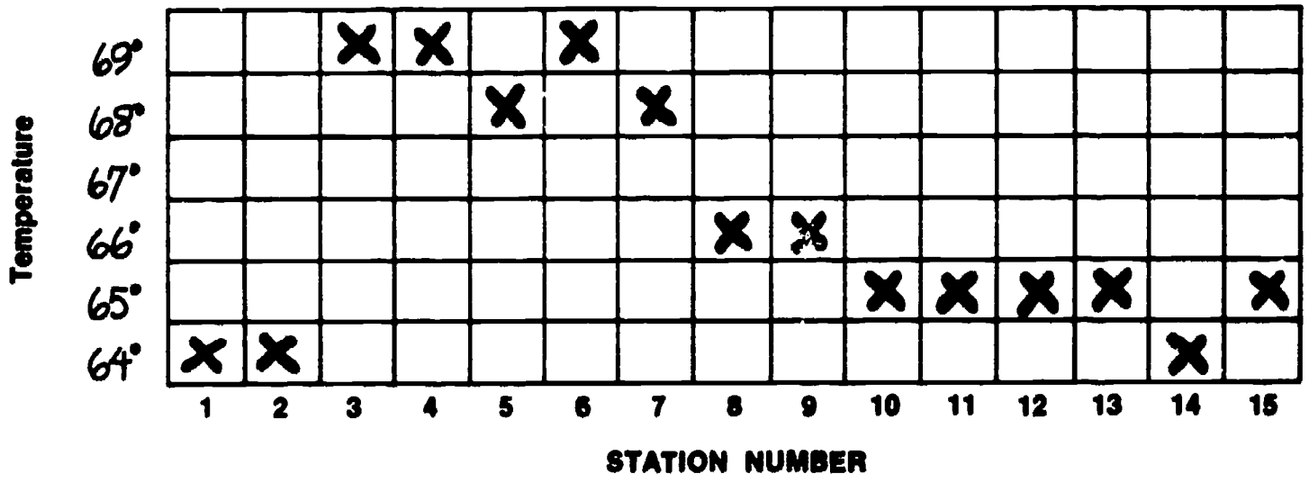
Graph #8



SOIL TEMPERATURE

Graph soil temperature against transect stations.

Graph #9



Data Sheet #1 (For the Pre-trip Activity and Field Site Activity)

Location _____ Partners _____

_____

Plant Samples	Total Number of Each Kind of Plant
(attach bag here)	_____
(attach bag here)	_____
(attach bag here)	_____
(attach bag here)	_____
(attach bag here)	_____

Data Sheet #2 (For the Pre-trip Activity)

Team # _____ Members: _____

	Location _____	Location _____	Location _____
Surface Temperature			
Soil Temperature			
Time			
Soil Description			
General Location Description			

Data Sheet #3 (For the Field Site Activities)

Transect number _____ Name _____

_____

1. Temperature—morning

a. air temperature _____

b. surface temperature _____

c. soil temperature (3 cm. down) _____

d. sub-soil temperature (20 cm. down) _____

2. Take one sample of each type plant found within sampling station.

(attach bag here) Total number of plants _____

(attach bag here) Total number of plants _____

(attach bag here) Total number of plants _____

Data Sheet #4 (For the Field Site Activities)

Transect number _____ Name _____

3. Pick a twig or leaf from each type of plant which is *taller than your knees, but shorter than you are.* These must be touching or hanging over your sampling section.

(attach bag here) Total Number of Plants _____

(attach bag here) Total Number of Plants _____

(attach bag here) Total Number of Plants _____

4. Take a twig or leaf sample from each type of plant which is *taller than you are.* These must be touching or hanging over your sampling station.

(attach bag here) Total Number of Plants _____

(attach bag here) Total Number of Plants _____

(attach bag here) Total Number of Plants _____

Data Sheet #5 (For the Field Site Activities)

Transect number _____ Name _____

5. Temperature—afternoon _____

a. air _____

b. surface _____

c. soil temperature _____

d. sub-soil temperature (20 cm. down) _____

6. Soil sample (handful put in bag)

a. soil 3 cm. down (finger length)

(attach bag here)

b. soil 20 cm. down (or half way to your elbow)

(attach bag here)

Data Sheet #6 (For the Field Site Activities)

Transect number _____ Name _____

_____

7. Soil Moisture, What Is It? _____

a. Dry—falls apart and sifts between fingers.

b. Slightly moist—appears moist but does not stick together when squeezed.

c. Moist—sticks in a clump when squeezed.

d. Very moist—squeeze and the water is obvious.

e. Wet—water drips.

8. Ground Insects (pick up with fingers). Add a small amount of alcohol to bag.

(attach bag here)

9. Insects on Plants (make ten sweeps with the net). Add a small amount of alcohol to bag.

(attach bag here)

Data Sheet #7 (For the Field Site Activities)

Transect number _____ Name _____

_____

10. Wind (sketch of the thread's angle)

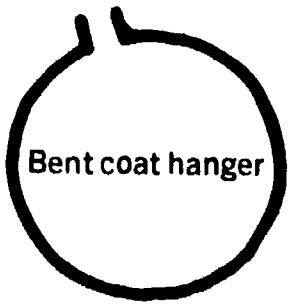
a. on the ground

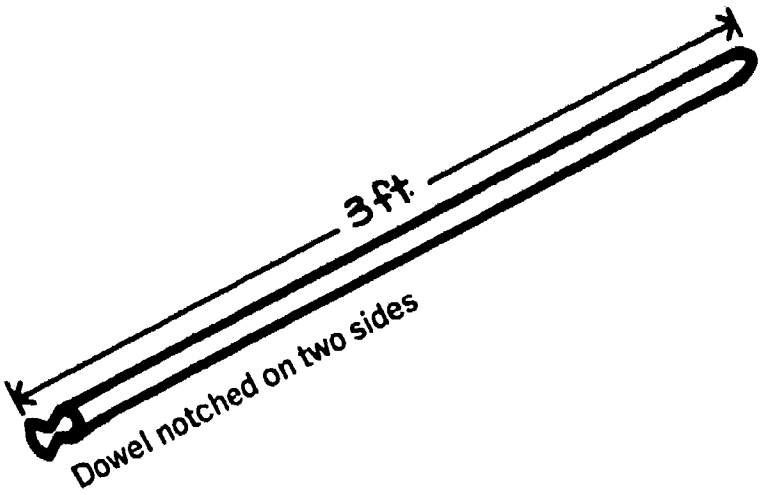
b. at waist level

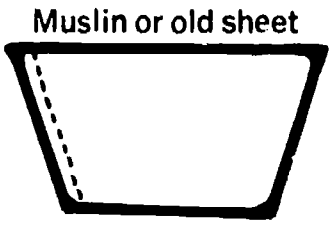
c. above your head

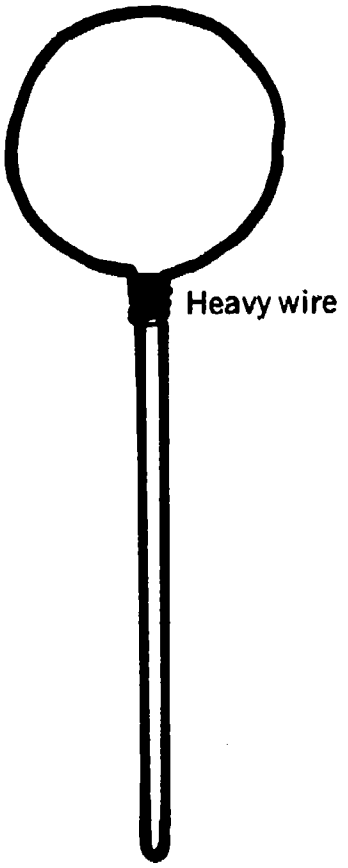
11. Light Intensity—Number of Faded Sheets _____

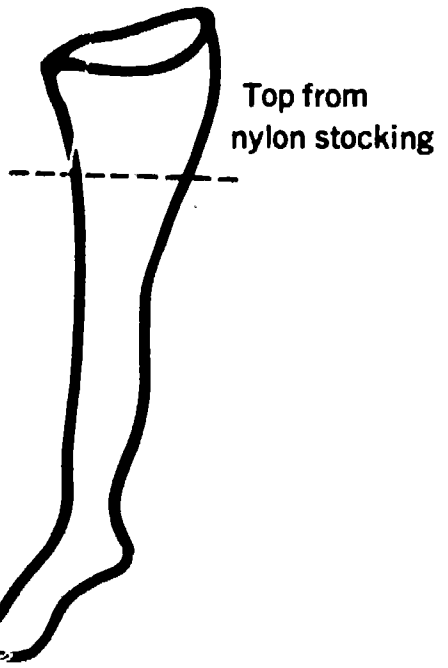
Insect Net Instructions

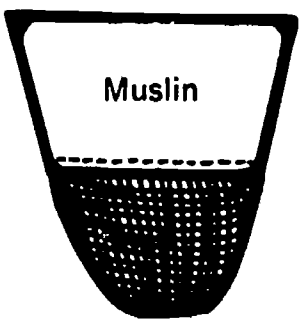


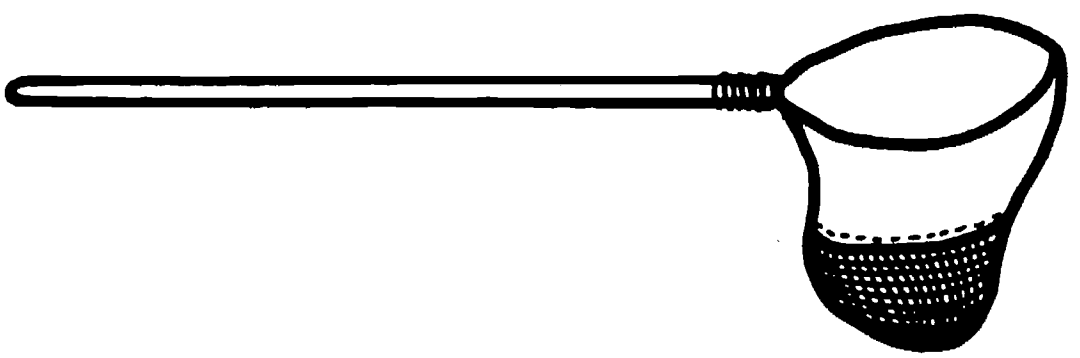












THE ENVIRONMENTAL UNITS

Below is a list of the twenty-four titles in the Environmental Discovery Series. Next to the titles, we have suggested the grades for which each is most appropriate. We emphasize that these are suggested grade levels. The teacher is encouraged to adapt the activities to a wide range of grade levels and subject areas depending upon the interests and abilities of the students.

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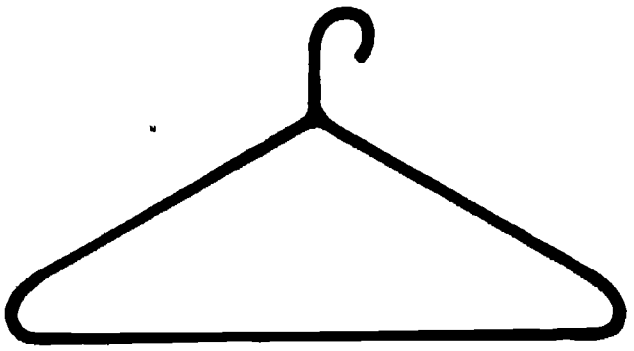

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