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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 construct a stream profile based on information collected at a portion of a local stream. Teams of three, working ten feet apart, are responsible for recording data on temperature, elevation, type of stream bottom, and plants and animals in the section. The data are then combined with the rest of the class and the profile drawn. Students are prompted to note patterns described by the stream profile and to relate that information to other similar streams. For teachers, the unit includes directions for building the equipment needed, ways of organizing a field trip to the stream area, methods of collecting and recording data, and questions for discussion. The activities can be used with students in grades 4-9. (MA)

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SE 018 532

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, nongovernmental 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.

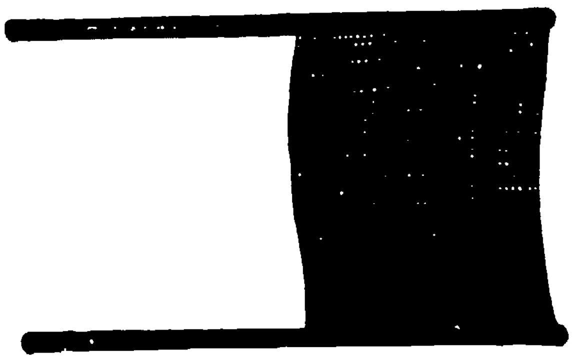
Stream Profiles

An Environmental Investigation

BY

NATIONAL WILDLIFE FEDERATION

MINNESOTA ENVIRONMENTAL SCIENCES FOUNDATION, INC.



Design and Illustrations by
JAN BLYLER

In **Stream Profiles,** students investigate a portion of a stream. They make observations of certain factors including water temperature, stream organisms and stream bottom composition. As a result of their studies, they begin to understand that a stream has *pattern* to it. The pattern will be consistent over the length of the stream as long as certain other influencing factors—in particular the velocity of the water—do not change. If the students can grasp the idea that pattern is *arrangement* and *orderliness* (see **Plant Puzzles,** another unit in this series) they should be able to understand that similarity among natural communities results from the similarity among certain interacting variables. Simply stated, things are where they are because conditions favor their existence. Thus, it is possible to find the same organisms thriving in habitats which are widely distributed geographically, as long as each habitat is characterized by the same elements or components. If, for example, one collects organisms from streams draining into a river, most of these streams, though miles apart, will contain the same organisms, assuming the streams are characterized by similar elements.

Knowledge of patterns, such as those involving stream organisms, bottom composition and other physical factors, contributes to one's ability to predict certain events—to generalize to similar situations. **Stream Profiles** is intended, in part, to help students develop the ability to see similarities and draw generalizations. We also hope that through the activities in this unit, students will enjoy learning about their environment.

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INTRODUCTION

Freshwater communities can be divided into two types: (1) standing water, such as ponds, lakes, and swamps, and (2) running water such as rivers, creeks and streams. The *degree* of water movement has much to do with the *kinds* of organisms found in these aquatic communities. There are cases of streams with associated pools where the water moves sluggishly or not at all. Organisms that are ordinarily typical of ponds can sometimes be found in such pools. Thus, the *range* of **aquatic habitat types** found in many stream communities explains, in part, the variety of organisms which can be collected in those communities.

The stream community is an exciting one to explore. Most streams contain a large number of species whose adaptations to life in swiftly flowing water are intriguing. A brief investigation of stream water ordinarily yields enough biological material for weeks of study. In addition to investigating biological relationships, students can also look at a number of other factors which affect the distribution and types of organisms found in a stream. Topology, velocity, bottom composition and temperature gradient along a stream's length are all significant determinants of organism types and should be studied as part of stream ecology.

In order to understand the ecology of a stream, it is important for students to do field work at a stream site. Such sites are not always within walking distance of schools. When this is the case, a field trip to a nearby forest preserve or other area should be considered. Often you can get permission to use private property as a study area. Your state Department of Conservation and other conservation agencies may be able to locate a field trip site for you.

In doing the activities of this unit, the students will work in groups or teams of three. Each group will study a ten foot section of a stream by observing temperature, sampling organisms and sampling the stream bottom. The ten foot sections will be adjoining each other; thus, if you have ten teams in your class, the class study will cover 100 continuous feet of the stream. The data derived from the investigations will be plotted on a large profile map of the stream which will be constructed by surveying and plotting changes in stream elevation. Finally, the students will attempt to draw correlations between elevation and the other data relating to temperature, stream bottom composition and organism types. All of these activities should provide background information for discussion and further investigations. The end of the unit contains several ideas for follow-up activities. We hope you will take advantage of these and use them to generate more ideas and spark student interest in learning about the environment.

MATERIALS

- mason's levels
- poles, clear pine, 1″ x 1″ x 10′
- screening—standard mesh in 2′ x 2′ pieces (1 per team)
- doweling—¾″, 36″ lengths (2 per team)
- strong string
- tacks, staples
- red tape
- plastic bags
- butcher paper
- graph paper—2 sheets per team
- rope (for measuring)
- metal-backed alcohol thermometers
- tape measure

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Stream Profiles

Pre-field Trip

I. Choosing a Field Site

Prior to beginning the field activities, you should decide on the stream site where the class will be carrying out its investigations. The students will need to wade in the stream. Therefore, the stream should be slow moving enough and shallow enough so that it does not present a danger to the students. For every team of three students you will need ten feet of stream. If you have a class of thirty, you will need 100 feet of **continuous** stream length.

II. Building the Equipment

In carrying out the investigations in this unit, it is necessary to use certain equipment. In this section the students will build the devices needed.

Gather together the materials from page 3. Often the students will be able to find these items at home. The exact number of poles, pieces of screen, mason's levels, etc. needed will depend upon how you wish to organize the activities. You can have each team make its own range pole measuring device and screen sampling device, or the class can make one or two of each apparatus and share them.

Set a deadline for bringing materials to class. When everything is assembled, construction can begin.

Pictures of equipment and instructions for assembly and use follow. In the back of the book on page 11 are illustrations of the devices. You can duplicate this page and give it to each team to help with construction. It might take several periods to finish making the devices. Also, you should plan to have the students spend one or two periods practicing with their equipment before going to the stream site. Allow about half a day for the activities at the stream site.

Stream Sampling Screen

To make the stream sampler, wire screening is wrapped around the dowels and tacked or stapled in place. Use enough staples to secure the screening to the dowels because the apparatus will receive some abuse when used.

The screen sampler is used as a means of collecting floating organisms or as a surface for sorting out debris taken from the bottom of the stream. Floating organisms are collected by grasping the screen device by its handles and running the end on which the screen is attached along the bottom of the stream at a slight angle, against the current. As the screen is being moved along, its bottom edge should be kept close to or in contact with the bed of the stream so that organisms will not easily slip under the device. If debris is collected—rocks, water plants, leaves, etc.—the screen can then be placed on the ground so that its contents can be examined. The screen will prevent most of the larger organisms from escaping to the ground. As noted earlier, each team will need to use the screen sampler; you could have each make one, or let the class make two or three altogether and have the teams share.

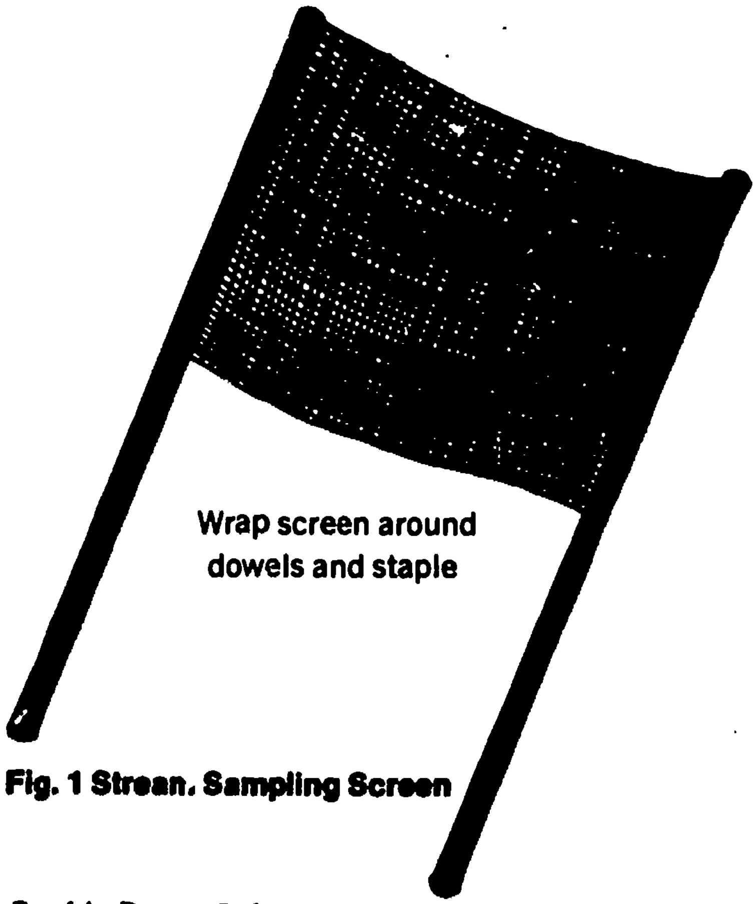

Fig. 1 Stream Sampling Screen

Double Range Pole

The double range pole measuring device is used to measure elevation of the stream bed along the length of the stream your class is investigating. The device consists of two poles—range poles—made of 10-foot lengths of clear pine, a piece of string, and a mason's level. Each range pole should be marked off into one-foot intervals, and each interval should be labeled with a number, starting with #1 at the mark which is one foot up from the bottom. Colored tape could be used to mark the intervals. A length of string, preferably 10 feet, is strung between the two poles and a level is attached to the string. Levels of the type recommended have hooks for easy attachment. One end of the string must be tied tightly around one of the poles about two inches from the bottom. The other end of the string should be tied loosely around the other pole so that it will slide up and down during use.

While the activity requires the construction of only one range pole device, the students may make as many for the class as time and resources permit. Again as with the screen sampler, each team will need to use the range pole device during investigations. If only one or two devices are made, the students can share them. (Detailed instructions for use are in "Section III, Practicing," below and on page 7.

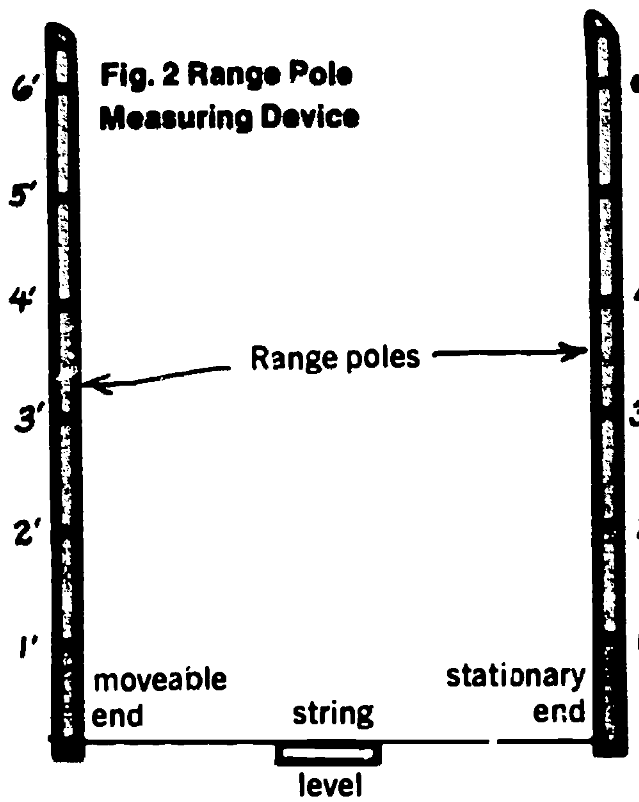

Fig. 2 Range Pole Measuring Device

Marker Rope

A rope marked at ten-foot intervals can be used to indicate study sections for the teams. It would be best if the rope is long enough so that it extends the complete length of the stream which the class is studying. It would also be good if the rope could be kept in place along the bank while the students are making their investigations. Two successive marks on the rope will indicate the upstream and downstream limits of a team's study section.

III. Practicing

The class should be made aware of the purpose of the field trip—the investigation of a stream, its biology, and its physical features. Several class periods can be spent building the equipment and practicing its use.

The double range pole will be used to measure the changes in stream elevation. The measurements will result in a profile of the stream which will be used as the basis for organizing the other data collected.

Once the double range poles are completed, assign a team of three students to each set of poles. Take the class into the hallway or to another area which you know is level. Have each team move its poles apart until the string is stretched taut and then slide the movable end of the string up or down the pole until it is approximately the same height from the floor as the fixed end. Then have each team attach a level to its string, midway between the poles. Adjust the movable end of the string until the bubble reads level—orienting itself between the two marks on the glass tube. Make certain all the students observe this and understand how to check whether something is level. (See Figure 2.)

When you are certain students understand that the centered bubble indicates the floor is level, remove each mason's level and move the range pole teams to a set of stairs, a curb, a hill, or other area which has different levels. With the string stretched taut, have each team place its poles so that the pole which has the string in a fixed position is on a higher level than the other one. Leave the *movable* end of each string about two or three inches from the bottom of its pole.

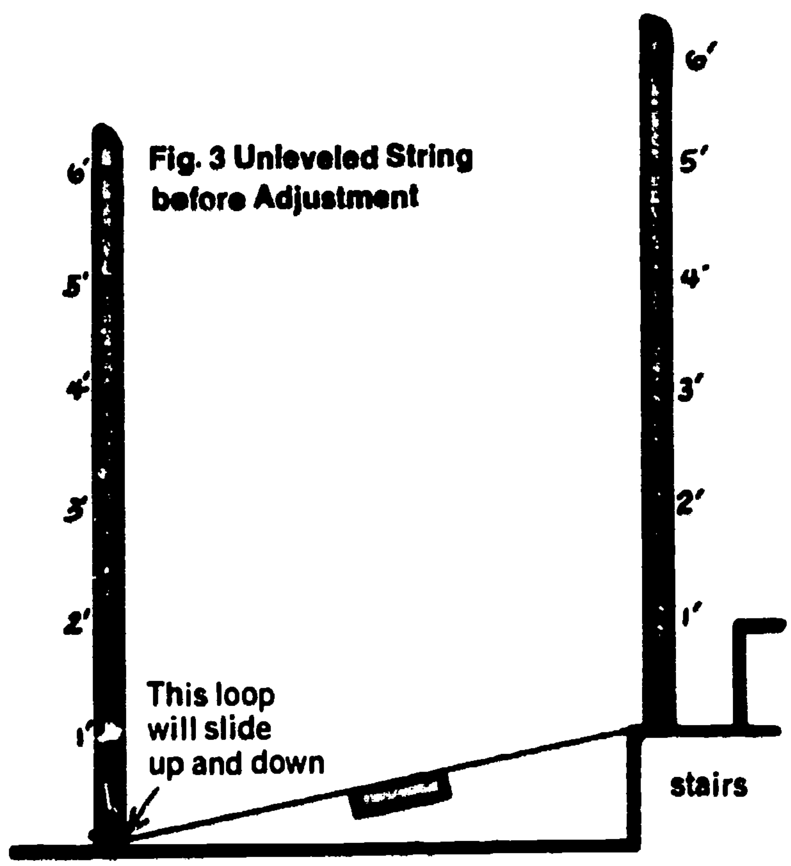

Fig. 3 Unleveled String before Adjustment

Again have each team place the level on its stretched string. (See Figure 3.) Ask: Does it read level? Without moving the poles, how can each device be made to read level? Hopefully, the students will suggest moving the string up the lower pole. (See Figure 4.)

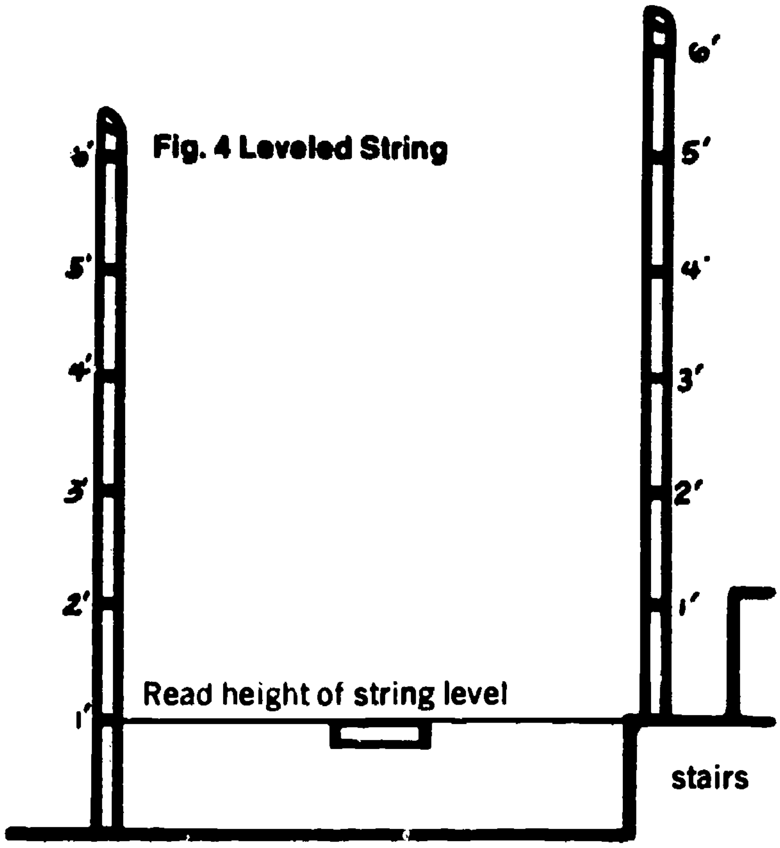

Fig. 4 Leveled String

Once the string is level, ask if it is possible to know the elevation of the higher pole without moving any of the equipment. Hopefully someone will suggest that the height can be read on the lower pole at the point where the movable string is now attached. Since the pole is marked in one-foot intervals which are labeled by distance from the ground, a fairly accurate reading can be made. Some estimation may be necessary to determine the number of inches above a foot mark.

The students might need several trials to get used to the double range pole. Allow enough time for practice so that all can use it with accuracy.

Field Trip

MATERIALS

double range poles	*plastic bags (several for each team)*
screen samplers	*thermometers*
marked rope	*labels*
paper	

Warn the students to wear appropriate field clothing—old clothes, high boots, etc. You will also want to discuss field trip behavior with them. Especially caution them to be careful around the water.

Give a letter or number designation to each team before the trip and make each team responsible for transporting its own equipment. It is recommended that students read about aquatic environments *after* the trip. Written material will have more meaning for them after they have had the experience of firsthand observation.

When the class arrives at the stream site, stretch the rope out on the bank along the section you have chosen for the investigation. Assign each team to a ten foot section. It will facilitate handling the data once back in the classroom if the teams are assigned stream sections in ascending order of their team number or letter designation, with the first team studying the most downstream section, the second team the next section upstream, etc. Give each group a large piece of paper for notes and data which they may want to record. Clipboards or notebooks could be used to write on.

If the stream is clear, ask each team to make an inspection of the bottom of its section. The students should note patterns formed by the distribution of materials along the bottom. Some portions may contain large pebbles, others might have sand or silt. Portions may be differentiated by color and particle size. When each team has finished observing the pattern of its ten-foot section of stream bottom, ask each to make a sketch of the section of stream, showing the general pattern made by the different bottom composition materials. The view should be the one which you would see if you were looking down on the stream from directly above. Following is a sample drawing similar to that which some teams might make:

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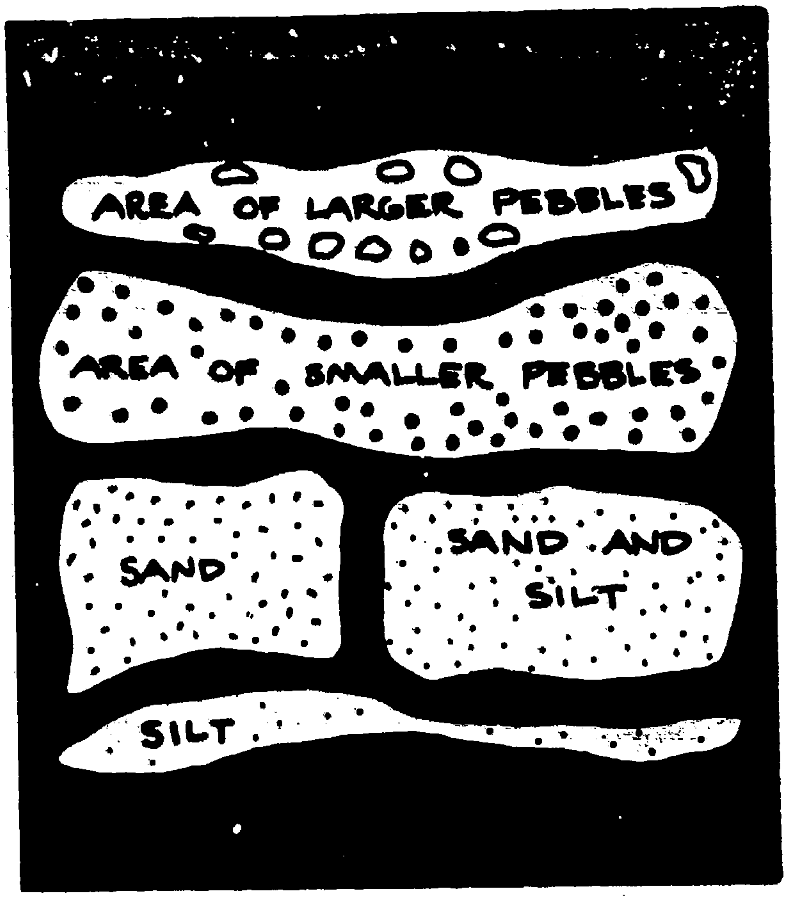

For each part of the stream bottom pattern (sand, silt, pebbles, etc.) each team should carry out the investigations which follow. If you are sharing range poles and screen samplers, you will probably want to have some teams do one activity while others do another.

1. *Temperature*—Each team should take water temperatures for its ten-foot section. There should be as many readings as there are parts of a pattern. Temperature differences may exist if there are significant differences in the stream bottom. Have a team record each temperature in the appropriate section of its sketch. Also, have each team record the air temperature.

2. *Samples*—Each team should collect samples from each different type of bottom section in its ten-foot interval (rocks, sand, gravel, etc.). The different sample types should be kept in separate plastic bags. The bags can be identified with labels keyed to the team's drawing of the stream bottom composition.

3. *Organisms*—Have each team sample each distinctive section of stream bottom within its ten-foot interval, checking for small organisms. A team should do this using the following procedure: have one team member grasp the screen device by its handles, stand at the downstream edge of a distinct section of stream bottom (sand, fine gravel, mud, etc.) and place the screen end of the sampler on the bed of the stream. (See page 4 for earlier discussion of procedure.) Move the screen upstream, gently agitating the stream bottom with the device as it is moved along. Keep moving the screen until it has reached the upstream edge of the section, and then lift the screen out of the water and place it on the bank. Sift through the material and collect any organisms found there. Keep only one sample of each organism from a given section and return the rest to the stream. Put all those organisms which are collected from a distinct section of an interval into a single plastic bag. Put a little water in each bag and close the bag by tying a knot or wrapping a rubber band around the end. Again, identify each bag with a label keyed to the team's drawing of the stream bottom.

Have students also gather leaves and sticks from the distinctive stream areas and place them on the screen for examination. Any animals found adhering to these objects should also be collected in the appropriate plastic bags. Have students make a thorough search of the debris.

4. *Elevation*—The class should use the double range pole to detect elevation changes in the *overall* stream section being studied. This can be done by having each team record the total elevation change from the beginning to the end of its ten-foot stream interval. Elevations should be measured in the stream, if possible.

The same elevation measuring techniques used in the team practice session at school will apply here. Specifically, one team member should stand at the upstream limit of his team's ten-foot section.

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He should use the range pole that has the string in fixed position. He should hold this pole vertically in the stream. Another team member should go to the downstream limit of the ten-foot section and hold the other range pole vertically in the stream. Attach the mason's level mid-way on the string. Pull the string tight. Adjust the moveable end of the string up or down until it reads level. With the string level, the drop in stream elevation can be determined by recording the height of the string at its point of attachment on the downstream range pole.

Students may have difficulty measuring stream elevation changes if these changes are slight. In this case, have the students mark off inch, or even half-inch intervals on the lower range pole.

5. *Plant Materials*—Have each team collect a sample of the different types of plants growing in the stream from each distinct area of its ten-foot section. A team should put all the plants it gathers from a given area into a plastic bag and label the bag by keying it to the drawing of the bottom composition.

Each team can also gather a sample of each type of plant growing along the banks immediately adjacent to its section. These samples should be put in bags and labeled appropriately.

Students should spend some time familiarizing themselves with the general area, land features and larger vegetation types growing near the stream. Many of them will enjoy walking along the stream watching other groups and comparing finds. Encourage them to share observations with one another. Check each group from time to time to make sure their observations are being recorded. If the stream is deep in any parts, or particularly fast flowing, you will want to warn them against placing themselves in a position which might lead to trouble.

When each group has made and recorded its observations, it would be worthwhile for the students to sit down together to discuss their work and discoveries. You might pose some of the following questions for their consideration.

ASK THE STUDENTS:

Were there any temperature differences between swift and slow moving portions of the stream? If so, how do you account for this? Where were most organisms found—attached to sticks, leaves or other debris, or free-swimming? How can you explain this? How do some animals prevent themselves from being carried downstream with the current? What other observations can be made about the stream in addition to those already made? If we surveyed another stream several miles away, what might determine whether similar organisms and conditions could be found there?

Many students will want to know the names of the various animals found. For purposes of this study, they can make up some temporary names and assign these to the organisms. They should make certain, though, that no one animal gets two different designations. They should keep in mind that the names they give are temporary. All the organisms they find have names which are accepted by most scientists. Interested students can be directed to source books to find the common names for the animals.

The investigations suggested so far are by no means the only ones which can be made. Perhaps some others were suggested in discussion. Time limits and the level of sophistication of your students should guide the selection of additional investigations. Of particular importance in the study of streams is the velocity and oxygen content of the water. Both of these factors influence the type and distribution of animals; further investigation could include activities designed to test factors such as these.

Recording Observations

It is difficult to graph and record in the field, especially on windy days. If there are no enclosed shelters with picnic or other kinds of tables on the study site, the data should be taken back to the classroom for compilation. The specimens can be transported easily in plastic bags if they are in a small amount of water. Once back in the classroom, put the water and organisms from each bag into separate, open jars. Transfer the labels from the bags to the jars. The specimens should be ex-

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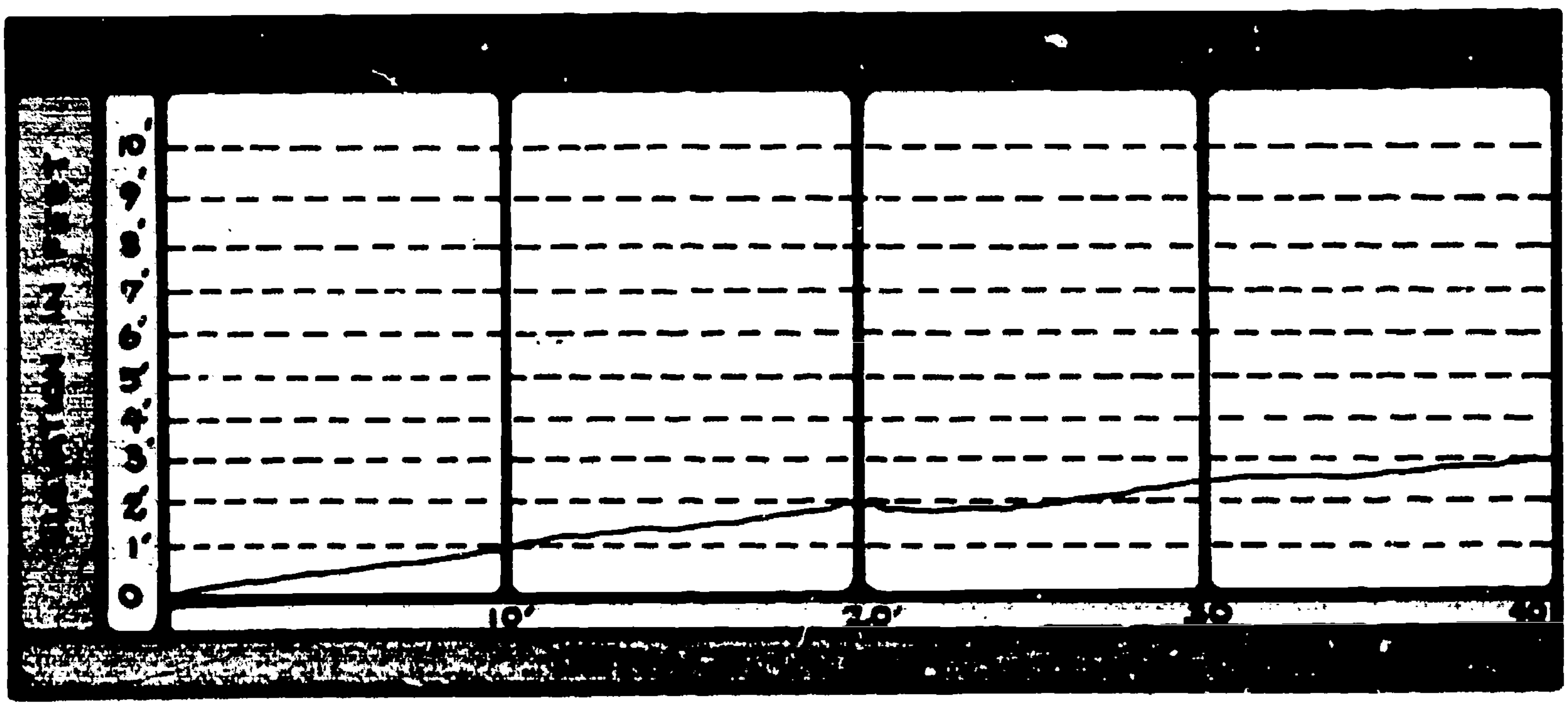
amined on the same day if possible because they will not live long in still water.

On the next day, lay out butcher paper on a large, flat table or on the floor. This will be used as a backing for making a profile map of the stream. Provide each group or team with one or two sheets of graph paper to tape to the butcher paper. All sheets should adjoin each other across the butcher paper. Sheets should be placed by groups in order of their position along the stream. The team which studied the section of lowest stream elevation should have its graph at the extreme left of the paper, the one at highest elevation at the extreme right with the other teams at points corresponding to their respective positions along the stream. As the profile develops, it will rise from left to right.

Assign the group whose section was at the lowest point in elevation the task of constructing an elevation scale on the left-hand margin of the graph. To do this, they must first find out through discussion what the total elevation change was. Beginning with the first group, have them report the change in their section; add to that figure the change found by the next group and so on until all groups have reported. Once they have a cumulative total, the students will know what the upper limits of the elevation scale should be. Thus, if the creek is found to rise ten feet from its lowest to its highest point over a 100-foot linear distance, the elevation scale would be 0 to 10 feet. Expand the scale sufficiently so that a large graph will result.

Now ask the first group to place the scale on the left-hand margin of the class graph. The horizontal scale on the class graph will represent linear feet. That scale will show the length of the stream section investigated by the class. If there were 10 groups, each working a 10-foot section, the horizontal scale will range from 0 to 100 feet. Let the bottom of each sheet of graph paper represent a 10-foot section of the creek. If each team is using two sheets of graph paper to represent its section, then one sheet will represent five feet. Have the teams indicate linear distance along the bottom of the graph.



Once the graph is set up, the groups can plot their stream elevation data. Each group should begin to plot the data at the point where the preceding group finished. Thus, if Team A's highest elevation was one foot, then Team B's lowest elevation will begin at that point on the graph. When all teams have plotted their information, the result will be a profile of the change in stream elevation over the distance measured. Above is a section of a profile graph which is similar to the one your class may make.

Once the profile has been constructed, other data can be plotted on the graph. Each group should attach the drawing of its stream bottom pattern above that section's profile on the chart. Air temperature could be recorded immediately above the profile line. The plastic bags containing bottom samples and organisms should be placed on the appropriate area of the pattern. Plant samples taken from the banks at the edge of the water can be placed on the corresponding portion of the pattern. (If some of the drawings are very small, have the groups enlarge them so that all the drawings are approximately the same size. It will also be helpful if the symbols used to represent different bottom materials are uniform. Thus large pebbles should

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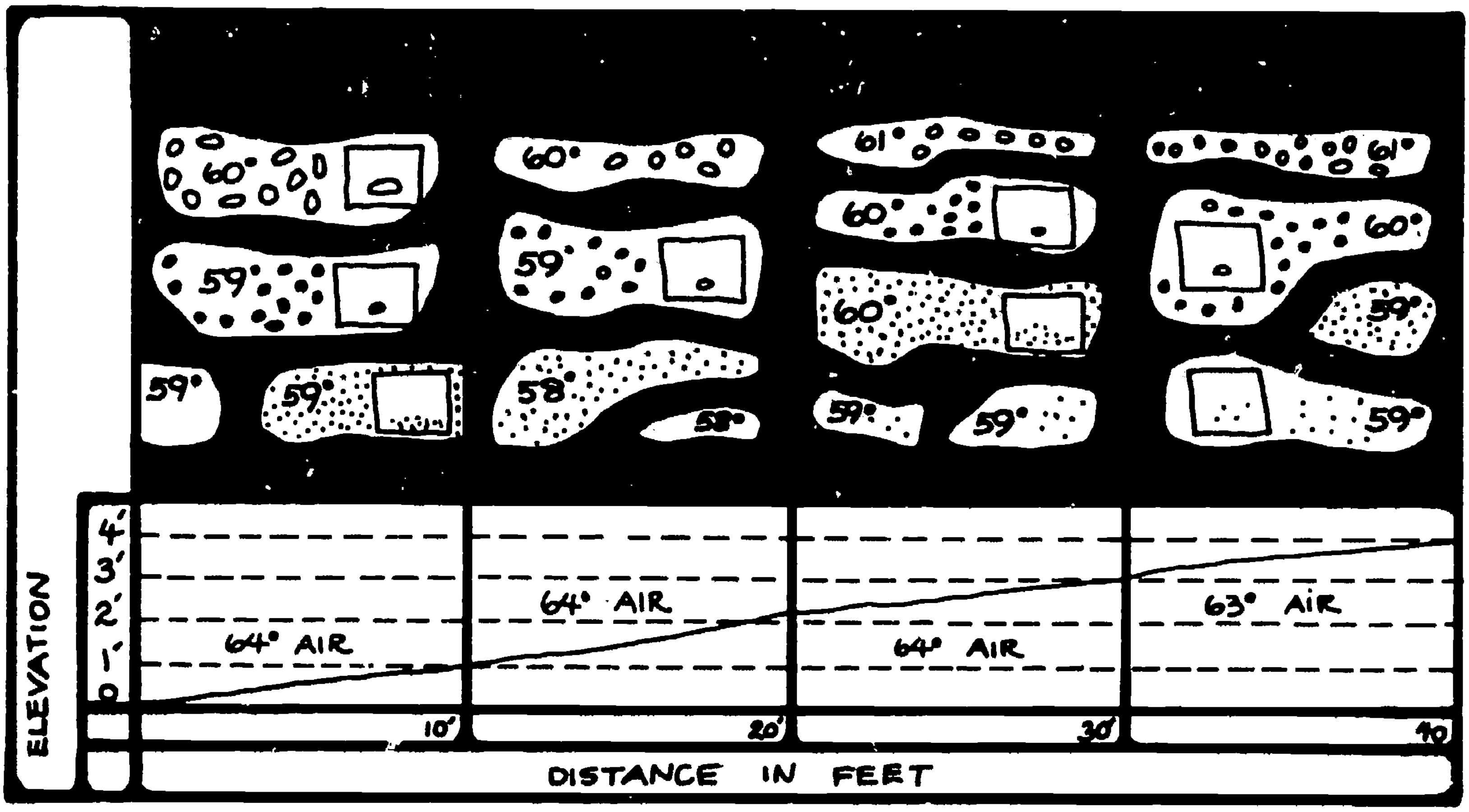
be drawn about equal in size on each sketch.)

If the students prefer, they may dry out their stream bottom samples for direct placement on the graph. Glue may be used to attach the material to the graph. Have the students refer to their recorded descripitons or to the keyed labels on the bags to aid in the placement of the material. The completed graph might look like the following:



DISCUSSION:

Once all the data are placed on the composite graph, the students should be given time to observe one another's data and collections of organisms. Have them compare their findings. Encourage them to choose names for their organisms so that they are able to communicate with one another about what they found. See if they are able to find any relationships between the following:

1. Elevation and temperature
2. Organism type and bottom composition
3. Air temperature and water temperature
4. Water temperature and bottom composition
5. Elevation and organisms
6. Temperature and organisms

Additional discussion might include:

1. Did everyone seem to find the same organisms? Were the organisms distributed evenly in numbers along the stream length or did they occur in a pattern? Is that pattern related to the stream bottom pattern?

2. If the stream began to dry up, and the water velocity decreased, how might this affect the kinds of organisms you found?

3. If the students have collected in fairly quiet pools along the stream, were the types of organisms inhabiting these pools different from those found in the main part of the stream?

4. What might be sources of food for the animals? Will they all eat the same thing?

5. Could one predict the relative velocity of the stream by examining the patterns formed on the stream bottom? How does particle size relate to velocity?

6. What could cause a change in the stream bottom pattern?

Additional Activities

1. Children may examine the organisms in more detail, identifying some of their possible adaptations to a swift stream habitat.

2. More field trips could be taken to find out if changes in seasons affect the stream.

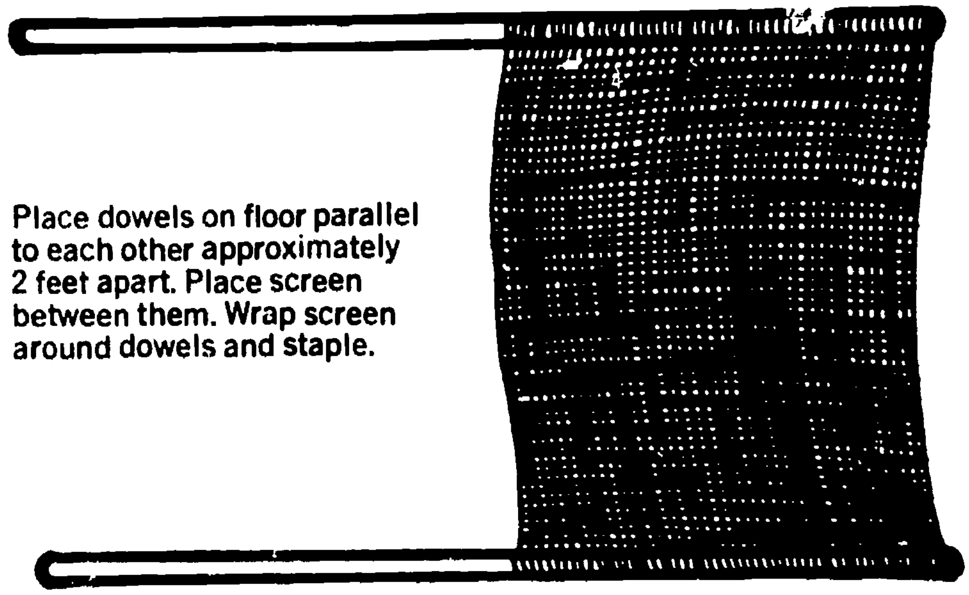
3. Additional data can be collected on stream velocity. Velocity can be computed roughly by throwing a floating object into the stream and timing it over a measured distance. Cotton, twigs, etc. could be used here.

4. A running-water aquarium might be constructed in order to maintain the organisms for further study. Additional collection trips can be made to obtain more animals. (See also **Change in a Small Ecosystem,** another unit in this series.)

Illustration Sheet

Stream Sampling Screen

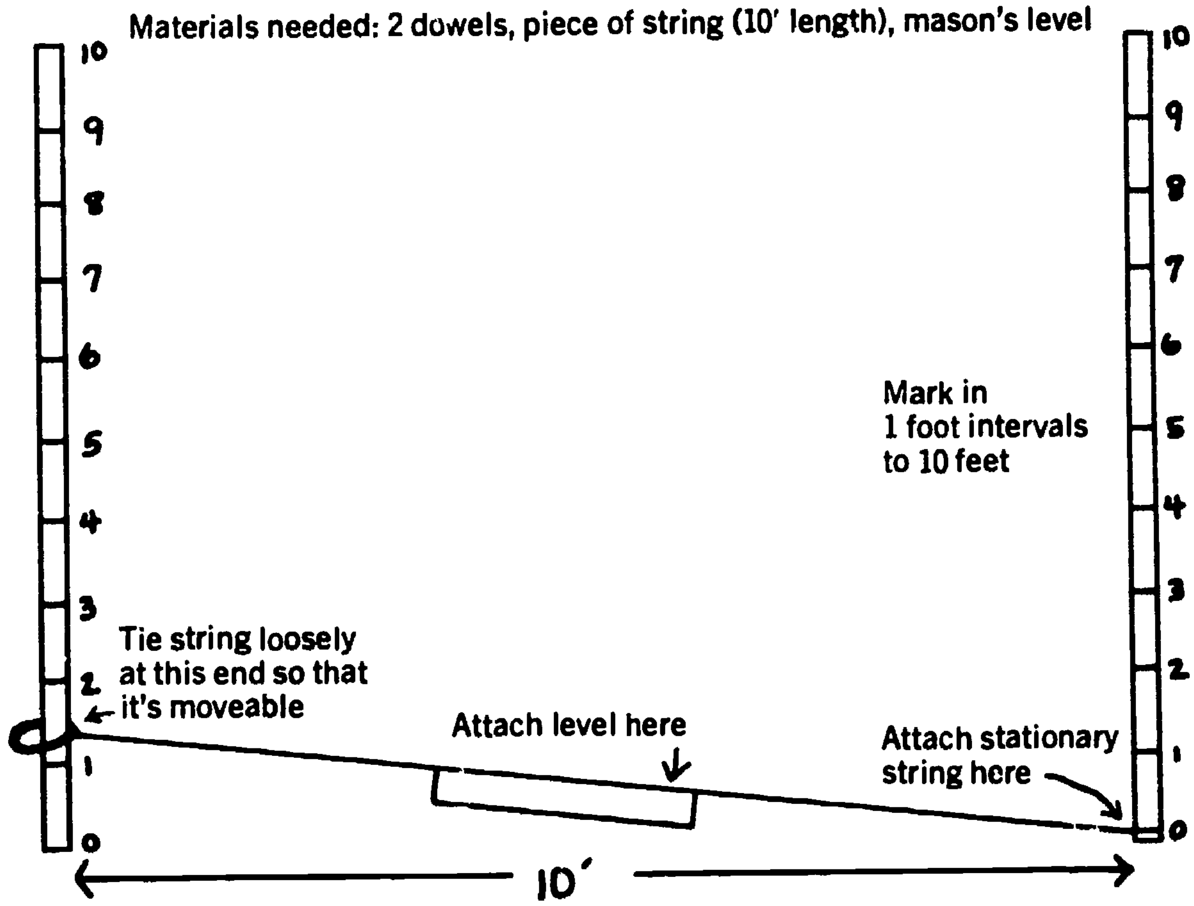
Materials needed: dowels (2), staples, stapler, screen (2'x2')



Place dowels on floor parallel to each other approximately 2 feet apart. Place screen between them. Wrap screen around dowels and staple.

Double Range Pole

Materials needed: 2 dowels, piece of string (10' length), mason's level



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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.

Order No.	Title	Grade Level	Price
79007	Plants in the Classroom	3-6	$1.50
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