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ABSTRACT

Techniques suitable for use with elementary school students when studying field environment are described in these four booklets. Techniques for photography (construction of simple cameras, printing on blueprint and photographic paper, use of simple commercial cameras, development of exposed film); for measuring microclimatic factors (temperature, wind speed and direction, humidity, light intensity, and soil moisture); and mapping (simple location of objects and contour mapping) are given. Instructions for making the apparatus required are provided and teaching strategies suggested. One of the booklets outlines a series of activities that can be conducted when studying a vacant city lot. This is felt to be an effective way of introducing biological principles to city children. The importance of man as part of the ecological system is emphasized by including a study of the biological effects of trash in the environment. All booklets contain background information for the teacher, and suggest ways the activities can be used to promote interdisciplinary activities. This work was prepared under an ESEA Title III contract. (AL)

PHOTOGRAPHY FOR KIDS

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PHOTOGRAPHY FOR KIDS

CONTENTS

COMMUNICATING WITH PICTURES

A child given a camera and some film, can become a recorder of his environment. He can stop time with his camera. He can record what is important to him, what is appealing to him, what is strange to him. He can record change with his camera. He may even become an artist with his camera.

Using a camera for a specific study can not only individualize the study, but add depth to the learning experience.

A child can take any study and use the camera to record activities and data. Children can record the appearance of a tree during several seasons or they may record the homes in their neighborhood. They could record the changes that take place in a building or street project. They could record and thus communicate everything one would need to know about baking chocolate chip cookies.

A camera is a tool much like a pencil. The child needs to be given many opportunities to manipulate it, to experiment with what it can do, to follow directions as to its uses and to solve communication problems with it.

Children will respond to the use of a camera in many ways. Some will be satisfied with a few reasonably good pictures. Other children may find it a satisfying form of self-expression. Still others may wish to delve into the science of photography and wish to develop negatives and print pictures.

This guide includes complete instruction for using photography with children. It also includes suggested problems to pose to the children so that they will become aware of stopping time with a camera, seeing interesting patterns, and using light.

MATERIALS NEEDED

Print developing trays, 3, 6, 9, or 12 per class

Photographic contact paper, "No. 2" or "No. 3" - 4 x 5 inch size or to fit negative sizes.

Blueprint paper from local blueprint co. or manufacturer

Cameras -- 25¢ from Goodwill or Salvation Army
Roll Film -- 12 - 15¢ discount stores
Plastic pails for tanks, 30 - 50¢, or developer tanks (1-4) per class $3.00 - $6.00 each
Solutions -- Camera shop

Developing film

Developer -- Ethol 90, fast, or Microdal, slow
Stop bath
Fixer -- any acid fix - use for developing and printing

Printing pictures

Print Developer -- Dektol

Brown or opaque bottles to store liquids -- 4 or more (mix solutions as needed)
Plastic pails -- 1 gallon size -- 4 or more
Funnels -- 3 medium size

Hand darkroom (see instructions)

Box
Black opaque plastic
Masking tape

Hand lenses -- one per child
Milk cartons -- 3 or more per child
Masking tape
Tin foil
Black paper, construction
Black paint, tempera
Liquid detergent
Brush, small
Scissors, one per child
Manila paper for scrapbooks
Distilled water (not essential)
Plastic stick-um or two sided tape
Old photo negatives
Black opaque sheet plastic (1-3 mil.)
Clock for timing

PREPARATORY ACTIVITIES FOR STUDENTS

Preparation for Silhouette Printing

For Blueprinting:

Materials:

Cardboard or wood
Clear plastic (sheet) - heavy duty (4 mil.)
Clothespins (8 per set up)

Procedure:

1. Prepare both a large backing set up for printing whole plants (10 x 12 or larger) and a smaller backing set up for leaves or negatives (3 x 4).
2. Cut a piece of heavy duty plastic to fit the cardboard size you have.
3. Place the plastic on top of the cardboard and attach the clothespins around the edge. You will need clothespins only on one edge with the smaller size. (see printing procedure in the next section).

PREPARATORY ACTIVITIES

Printing with blueprint paper

Reproducing a natural item

Select the item to be printed. Working in a dimly lit room, cut a piece of the blueprint paper to the size of the backing set-up or the size of the item. Place blueprint paper between the plastic and cardboard of your print backing set-up, with the blue side up.

Arrange your natural item or items on top of the blueprint paper.

Place plastic tightly down over everything. Secure with clothespins.

Expose the plastic side to a strong source of light, direct sun, or light projector lamp until the exposed paper has lost most of its color. About 1-3 minutes in sunlight, and up to 5 minutes, plastic side toward light, on top of an overhead projector.

Trim before displaying.

Printing from a photo negative

When using negatives, use the same items - backing, blueprint paper, negative, and plastic. Expose to light in the same way. The resulting print is a reverse reproduction of the negative and looks like a blue photograph.

PREPARATORY ACTIVITIES FOR STUDENTS

Milk carton cameras

Materials:

Several 1/2 gallon milk cartons per child
Tracing paper or wax paper
Opaque tape
Pins - Straight sewing pins
Tacks
Pencils
Single carton camera

Procedure:

1. Neatly cut off the top of the milk carton trying to keep the edges straight.
2. Cut a piece of tracing paper or wax paper to fit over the open end and fold back about an inch.
3. Hold the tracing paper straight and stiff over the open end.
4. Have another person place the masking tape on to hold the tracing paper in place.
5. In the center of the bottom of the milk carton make a pin hole.
6. Hold this up to a window or a well illuminated object either inside the classroom or outside the window.
7. Focus your eyes on the tracing paper and note the image. To better see the image, shield the tracing paper from back and side light with cupped hands.
8. If the tracing paper is uneven or wrinkled, remove and replace it.
9. Make the hole larger with the tack, note the image changes.
10. Make the hole larger with a pencil point if you wish.
11. Make a second camera using shorter distance between the pin hole and the tracing paper.
12. Try the various size pin holes and see which one produces the clearest image, or the brightest image on the tracing paper. To test 3 hole sizes by comparing them at the same time, you will need three different cameras cut to the <u>same</u> length. To make a comparison test for image size you will need 3 or more cameras, using the same hole size, each cut to a <u>different</u> length. So if a child or group of children want to check three hole sizes and three different lengths they will have to make six cameras. Have plenty of milk cartons on hand!

PREPARATORY ACTIVITIES FOR STUDENTS

The work can be divided among teams. One camera can be used per team for still more economy but less fun. If the hole is made too large to show a sharp image, push a pencil through it to make it extra large, place a piece of black opaque tape over the hole and again make a pinhole.

13. Be sure each child labels his camera accurately with name, hole size, etc.

Double milk cartons camera

Materials:

The same materials are needed except two milk cartons per camera.

Procedure:

1. Cut the top off one milk carton.
2. Cut along the sides of this milk carton about three inches.
3. Place the pinhole at the bottom of this carton.
4. Cut both the top and the bottom of the second carton
5. Cover one end with tracing paper.
6. Slip the second camera into the first, tracing paper end first.
7. Aim this camera at a window, focus on the wax paper. Slide cartons in and out. You can change the size of the image by sliding in and out.
8. Experiment with different hole sizes.

Add a lens to the camera:

1. Use a simple magnifying glass.
2. Try to have several different strengths of magnifiers available for experimenting.
3. Center and enlarge the pinhole. Use a pencil to punch a hole or cut away the carton until the hole diameter is no more than 1/2 inch in diameter. Tape the hand lens over the hole of the camera. Do not put the tape over the center part of the lens.
4. Experiment with focus by lengthening and shortening the camera Can the image size be changed?
5. Note a brighter image.

Painting the interior of the camera:

1. To completely black out the interior of the camera, so that light does not penetrate the walls, paint the inside with powdered black tempera that has been mixed with liquid detergent rather than water.

PREPARATORY ACTIVITIES FOR STUDENTS

2. A less satisfactory method of sealing light is covering the outside of the carton with aluminum foil, being sure all folds or cuts are taped light tight.

Experimenting with print paper in the camera:

1. Select your best lens camera made out of one or two cartons. Tape the two cartons in the best focus position
2. Remove the tracing paper.
3. Paint the camera black inside and be sure it is light tight.
4. Replace the tracing paper with a hinged door. Make a door of cardboard or stiff black paper, being sure that the camera is light tight. Tape the hinge side of the door onto the camera.
5. Have opaque tape ready to seal the door closed after print paper has been put inside.
6. In a darkened room or dim room, place pre-cut blueprint paper on the interior side of the door. Hold in place with two-sided tape or plastic stick-um.
7. Close camera door and carefully seal the door closed with opaque tape.
8. Cover the hole by holding that end of the camera to your body.
9. Set the camera on a steady shelf or table where it will not be disturbed.
10. Expose the hole of the camera to a well lit object or scene such as a window.
11. Experiment with timing of exposure. There are so many variables it is difficult to suggest a good time to allow. Good results depend upon many experiments. The first experiments could be timed from 1/2 to 24 hours. Blueprint paper is not very sensitive to red light. It should be exposed to bluish and very bright light. Daylight is best.
12. Remove the paper at the end of the time allowed and "fix" by rinsing in water a minute or so. A reverse negative image should appear if exposure was for correct time.
13. To avoid duplication of effort, it is well to keep accurate and complete records on a class and individual basis. Make a large wall chart and record the results of each timing experiment including the name of each experimenter.

PREPARATORY ACTIVITIES FOR STUDENTS

14. You can try the same experiment using more rapidly exposed photographic print paper. You need to have print developer solution, water, and "fixer" ready for printing these pictures. Experimental exposure times would be in minutes rather than hours. See instructions for developing prints which follow.

PRINTING WITH PHOTOGRAPHIC PAPER

1. Select a photographic negative.
2. Prepare backing set up. (3" x 4" or smaller, or the blueprint set up will work).
3. Work in a room which is darkened as much as possible. Red light only, may be used for extra illumination. Red light bulbs can be obtained at a photo store.
4. Quickly remove one piece of photographic paper from the envelope.
5. Place between the plastic and backing in the following order:

   Cardboard
   Paper - shiny side up
   Negative - shiny side up
   Clear plastic
   Clip tightly in place with clothespin

6. Expose to a white light source - a clear glass 100 watt bulb 5 -10 feet away in a dim room for five to twenty seconds. Count out the time for the best results. Experiment with timing.
7. Pull the paper out quickly to place in print developer - keep it under and face down in a black tray if there is stray white light in the room Turn up the corner only to see if the image is formed.
8. When the image is completely developed the edges of the paper will be black, but other portions will be shaded in light gray tones. Quickly place the paper directly into "fixer" solution for ten minutes. If print is too dark, it was exposed to the light bulb too long, try again. If too light, expose longer.
9. Wash picture in running water (a pail under a running tap) for 1/2 to one hour.
10. Place paper between layers of paper toweling and press flat with a weight until dry (overnight).

We encourage you to teach the printing technique before developing negatives because we feel it falls into line as a steady growth of the experience of printing. If it would fit your purposes to teach developing negatives first and then printing, please do so.

PROCEDURE CHART FOR DEVELOPING PAPER PRINTS

This procedure will work in a dimmed room if the paper is protected from stray light and work is done quickly.

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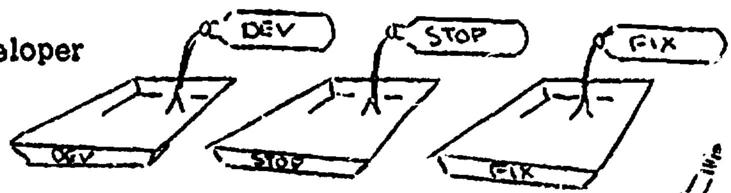
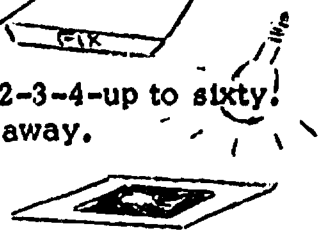
1. Fill three trays
   One with paper developer
   One with stop bath
   One with fix

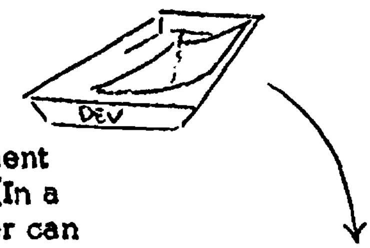


2. Expose paper one to 30 seconds or counts of 1-2-3-4-up to sixty!
   Experiment, keeping the light the same distance away.



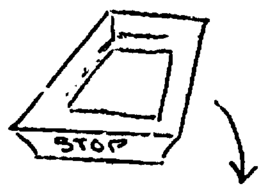
3. Place paper face down in developing tray.

4. Agitate paper.



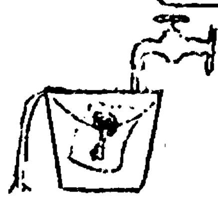
5. Turn up corner to watch development do not develop over 2 minutes. (In a darkroom with red light, the paper can be turned face up).

6. Quickly put the paper face down in stop bath.

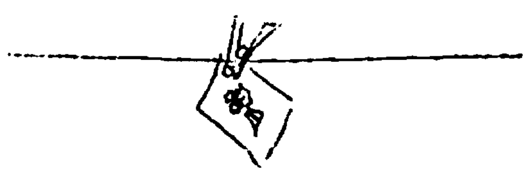


7. Put paper in fix, face up is okay.
   Lights can be turned on after 2 -3 minutes in fix.
   Fix for ten minutes.

8. Put paper print in another tray or bucket and wash in running water for at least one hour.



9. Hang print up to dry or place between paper towels and press until dry.



EXAMINING COMMERCIAL CAMERAS

It is important that each child have a chance to examine all of the cameras available to the group. A child should have a chance to open them, make comparisons, and try out all the moving parts. He should have an opportunity to determine the similarities between milk carton cameras and the commercial cameras. If possible, have a camera or two that can be completely dismantled.

Familiarity with the cameras can be encouraged by having all cameras out on a table and permitting small groups to examine them at their pleasure. Encourage children to exchange ideas about the cameras.

A game can be played similar to "hot potato" called "wonderful cameras." Pass the cameras around the table carefully; at a signal, stop and examine the camera in front of you. You can also play this game as musical chairs with the children moving around the table.

After sufficient time is given, have teams of two or more, depending on how many cameras are available, select a camera. Have them determine how to load it with film. Practice with a spare roll.

LOADING THE CAMERA

After sufficient examining time has been given, have teams of two or more, depending on how many cameras you have available, select a camera to use. Have team decide how to load it and compare the loading with other cameras. You may need to review this with some teams.

Distribute film, load, determine or review how the film is moved to the next position, and begin taking pictures.

TAKING PICTURES

The first few rolls of film should be considered "free fun film." Of course all picture taking should have the element of free fun, but you probably will find it hard to get them interested in solving problems with pictures if they have not had an opportunity to just determine the mechanics involved. Problems they enjoy solving with pictures are:

Can you tell me about your family with pictures?

Can you record the fun your family has together?

DISCUSSION AND GUIDELINES ON DEVELOPING FILM

Examining film:

1. Open and unwind an unexposed roll of film.
2. Note the layer of paper and the layer of film.
3. Examine the tape near the beginning end that holds the film to the paper.
4. Consider why there is tape at only one end of the roll.
5. Discuss which end of the film will be outermost after the film has been exposed and wound through the camera.

Examining and comparing a roll of undeveloped film and a roll of developed negatives:

1. Examine a negative with the question, "What is a negative? what makes it different from a picture?"
2. Discuss balck and white tones on negatives. What do the clear areas represent?
3. A little background information for the group leader:

   Compare the strip of film to a developed negative, or better, a roll of negatives.

   The light colored coating on the film is composed of chemicals which react to light and also prevent that light from scattering once it hits the film.

   Will this roll of film be usable for taking pictures if it is rolled up and put into the camera? No. The chemicals have already reacted to the light that is hitting the film now.

   How can we tell if the chemicals have reacted? There is visible change in the strip of film we are looking at. The film must be developed. Another chemical process to give visible evidence of what reaction the light caused in the film. The developer makes all the places where the light struck turn black. The stop bath stops the developer from working. The fixer removes the extra chemical coating which did not get hit by the light and was not turned black by the developer. The fixer also removes the opaque coating which keeps the light from scattering. Washing the film in water removes the developer, stop bath, and fixer from the film as these will stain the film after a time.

DISCUSSION AND GUIDELINES ON DEVELOPING FILM, cont.

Why is the film transparent? If the chemical coating were put on paper, the resulting black and white image would be the reverse of what we see with our eyes. This is because the chemicals turned black where the light hit. We see things from which light comes as white or bright. As the children know from experiences with pinhole cameras, a negative image can be made by taping a piece of photo print paper in place of film in a camera and using a time exposure to record the picture.

If the image of the exposure to light within the camera turns out to be the reverse of what we see, then we need only reverse it again to see it realistically. Light is needed for the photo process of reversing the image, and the easiest method is to shine the light through the negative (the reverse image) onto the same kind of chemical coating which this time, has been put on paper instead of film. Therefore, the negative is exposed and developed onto transparent film. The positive (or the re-exposure of the negative) is exposed and developed on white paper.

If the undeveloped roll of film is dipped in fixer, the coating will be dissolved and the silver salt removed so that the film will be transparent.

It is possible to make a positive on transparent film. Then light can be directed through the film and a realistic image projected on a screen. Movies and slides work this way whether they are black and white or color. Some black and white and color films turn out positive upon first exposure. They are developed by a special direct reversal process which is too complex to go into here.

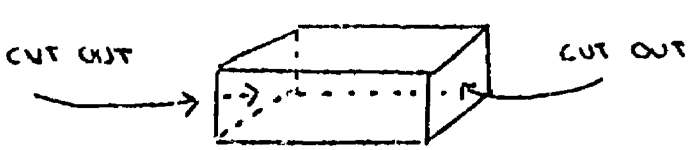
4. Discuss -- what would happen if you put this demonstration film into the chemicals now that it has been exposed to light? Why?

5. Plan to develop the exposed film to varify opinions.

How to make a hand darkroom

1. Obtain a small cardboard box, about 12" x 12" x 18"

2. Cut the ends out of the box.

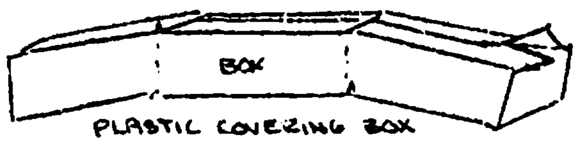


3. Seal the top and bottom with masking tape.

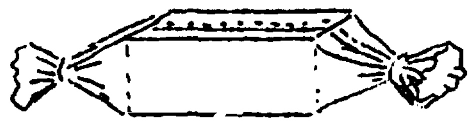
4. Purchase enough black opaque plastic (hardware store) to go around the box and stick out about 20" on each side.

DISCUSSION AND GUIDELINES ON DEVELOPING FILM, cont.

5. Stitch, staple, or tape the fabric together.



6. Seal the ends with rubber bands or string.



7. Developing materials are placed in the box.

8. The child puts his hands into the dark box, and seals the ends around his arms and works by feel.

Introducing the Hand Darkroom

1. Examine the hand darkroom box.

2. Determine the purpose.

3. Determine the use.

Introducing the Tank

Students should: (Refer to manufacturers instructions for use)

1. Take apart -- examine.

2. Ask any questions about parts.

3. Manipulate without film.

4. Demonstrate how film is loading onto spool.

5. Manipulate the spool to accommodate different size film.

6. Practice loading the tank with an old strip of negatives or the exposed film you removed earlier.

7. Practice loading with eyes open as long as necessary.

DISCUSSION AND GUIDELINES ON DEVELOPING FILM, cont.

8. Practice with eyes closed until feel confident.

9. Practice loading tank in the hand darkroom.

10. Open to check that loading is correct.

Loading a film developing tank in the hand darkroom

There are several kinds of photo developing tanks; each loading a little differently. If you can get the kind that has a clear plastic strip as a film loader that will be easiest for the children. The following are for the spool type tank:

1. Place the following items into the hand darkroom:
   a. Clean, dry, tank, cover and spool which has been adjusted to the film size.
   b. Film size to be developed.

2. Fit arms into the darkroom with the help of another person.

3. Seal arms with rubber bands or string.

4. Break tape from film.

5. Unwind paper covering film.

6. Unroll, trying to handle the film on edges only.

7. Locate tape at far end of roll which holds the film to the protective paper.

8. Remove and seperate film.

9. Place an end of film into spool being sure that the edges of film fit into grooves.

10. Clip the film onto the metal holder if this is provided.

11. Be sure that the film is secure.

12. Begin slowly turning the spool. As you do this you will feel the film rolling onto the spool. Be sure that the edges of the film are fitting into oposite grooves in the spool.

13. Try to touch film only along the edges but do touch it there in order to feel the films progress onto the spool.

DISCUSSION AND GUIDELINES ON DEVELOPING FILM, cont.

14. Continue until all film is wound on.

15. Place spool in a clean, dry photo tank.

16. Cover securely.

17. Remove tank, paper and old discarded film spool from the darkroom.

18. You are ready to use the developing solution.

DEVELOPING PROCEDURE FOR FILM

Correct timing of developing is important for success. You may wish to wait until all children who are doing this for the very first time are ready so that you can measure the time together. When their confidence increases, they can do this and all other steps independantly.

1. Measure amount of developer needed (Microdal X) in an extra tank or other marked container (keep mixed developer in brown bottles). Set tank which has been loaded with film into a small clean plastic pail.

2. Pour developer into tank. Be sure that it is filled.

3. If your tanks have stirring rods put them in place and rotate gently, taking "rests" whenever necessary. If your tanks do not have a stirring rod, gently rotate the tank.

4. Leave Microdal X developer in for eight to ten minutes.

5. Then quickly pour the developer out of the tank into the small pail.

6. Set tank in second clean pail and quickly fill with stop bath.

7. Gently stir for one minute.

8. Pour stop bath out of tank into the pail and then, using a funnel, back into the stop bath jar.

9. Now return to developer in the 1st pail and pour it back into the brown developer jar. Use a funnel.

10. Place tank into third pail and fill with fix.

11. Stir occasionally for ten minutes.

DISCUSSION AND GUIDELINES ON DEVELOPING FILM, cont.

12. Pour fix from tank into pail, then using funnel, return fix solution to its container.
13. Pour water into tank and dump out.
14. Remove spool from the tank and place in a pail for washing.
15. Wash in a pail under running water for 30 minutes.
16. Wash out all pails and tank with running water.
17. Hang film up to dry overnight. Hang by one end with a clothespin.

When the negatives are dry they can be used with print paper to make photographs according to the print developing procedure described earlier.

PROCEDURE CHART FOR DEVELOPING FILMS

FILM - Set up three solutions, three buckets and clean film reel and tanks.

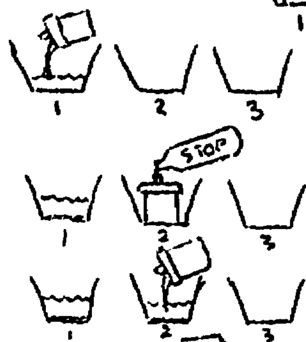
1. Exposure of film.

2. Load film on tank reel in the dark.

3. Set tank in bucket No. 1.

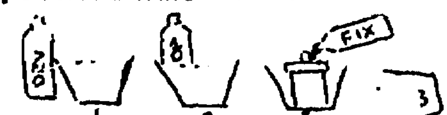
4. Pour in developer; note specified development time on label.

5. Agitate tank during development time.
6. Pour out developer into bucket.

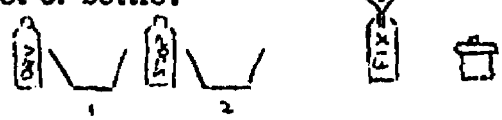


7. Put tank in bucket No. 2.
8. Pour in stop bath.
9. Pour out stop bath.
10. Put tank in bucket No. 3.
11. Pour developer and stop bath into storage bottles.

12. Pour fix into tank. Fix for specified time on the label or 10 minutes.
13. Agitate tank.



14. Pour out fix either into bucket or bottle.



15. Return fix to storage.
16. Put reel with film into bucket and wash in water - film may be taken off reel for washing - wash for at least 1/2 hour.

17. Take film from reel and hang up to dry.
18. Wash out pails and tank.

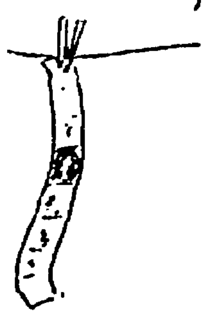


PHOTO CHEMICALS

There are a number of developing solutions on the market. Some come in a powdered form, others in a liquid form. Both come in quantities to prepare one gallon. Of course, you may mix smaller amounts such as one quart at a time.

When purchasing a set of developing solutions, three factors must be taken into consideration: (1) cost; (2) time for development needed; and, (3) ease of use.

When considering the cost be sure to think not only of the initial cost of preparing one gallon of developer, but consider the number of times one batch can be used to insure results. Some will suggest five uses, others up to nine uses.

The time needed to develop the film varies greatly. You can get developer that works in 90 seconds and others that work in three, five, or eight minutes. It would probably be wise to experiment with the various kinds and determine which would suit your purposes best. Tank development of film requires a slower developer because children cannot get the developer out of the tank before over-development occurs.

Ease of use refers to the differences between powdered or liquid form of solutions. When mixing powder into water you need to use warm water (100° - 120° F.) and then cool it to 70° F. before using. This fact may make it preferable to use the liquid developer.

There are four solutions needed to complete the entire process and end up with printed pictures. Three are needed for film development and one additional solution for printing along with the same stop bath and fix as used for film. Washing in water is required for both film and paper.

DEVELOPING FILM

Developer -- Microdal or Edwal, etc.
Stop Bath -- Stop bath (with indicator) or a small amount of acetic acid in water (5%).
Fix -- Kodak fixer.

PRINTING PICTURES

Developer -- Dektol, etc.
Stop bath
Fix -- Kodak Fixer

The same fix and stop bath are used for both processes; the developers are different.

It is essential to label the storage bottles carefully. Put a sticker on the bottles to record how many times the solution should be used, and space to mark off each time it is used so that you can keep track of when new solutions are necessary.

Neatness in handling and caring for these solutions is essential as is the care and cleaning of all equipment and the area being used.

Do not mix solutions or they must be discarded.

Safety precautions in handling both the concentrated chemicals and the solutions is important. Do not put into mouth or eyes. Do not get on clothing or leave on furniture. Keep all areas clean.

PREPARING SOLUTIONS

The specific listed developing and fixing solutions were used in trialing this activity, but there are many other developers which will work just as well for these purposes. The best resource of information on any solution is local photographic supply dealer. Advise him that you need a fast, medium, or slow (your choice) developer for crude work with roll film at the cheapest price. Sometimes convenience and results will offset the higher cost of some chemical preparations. For instance a developer solution is much easier to prepare from a liquid concentrate that from a powder.

All solutions should be mixed according to the manufacturers instructions on the label. Some chemicals may be irritating to the skin of some children. Under normal use and with precaution of washing hands after using the solutions, no ill effects should result.

DEVELOPERS

All developers deteriorate when exposed to air or light. Store developers in an opaque or brown bottle and cap tightly. Try not to store in only partially filled bottles because air included in the bottle will cause deterioration.

Prepare a gallon or more at a time. It is most convenient to store in quart bottles. One quart is about the right amount to fill a developing tank or tray.

Film developers can usually be reused for several rolls of film. However, each developer is different and you must refer to the manufacturer's instructions.

Paper developer should be discarded following development of several prints. These developers usually kept as a concentrate and then diluted for use. Refer to the manufacturer's estimate of the number of prints the solution will handle.

When a developer starts to turn dark brown and have a rank odor, it is used up or deteriorated. Throw it out.

STOP BATH

Stop bath is basically a weak acetic acid solution of about 2 - 5% concentration. Pure distilled vinegar will work. An indicator stop bath changes color when the acid is used up.

The acid in the stop bath quickly stops the action of the developer. This is rather important when using fast developers because the developer left on the film can cause overdevelopment in 1/2 to one minute. Also the stop bath neutralizes the developer solution and thus saves the life of the acid fixer solution.

A stock solution can be stored in any kind of container. Quarts are handiest.

FIXATIVE

Fixes usually keep well and do not require a dark bottle. They can be reused many times but a record should be kept of the amount of film or paper run through the fix solution so the solution can be thrown out when the manufacturer indicates.

Film or prints that have not been fixed completely because of too short fixing time or exhausted fix will turn brown or fade in time.

Prepare at least a gallon at a time and for convenience store in quart bottles.

WASHING

Films and papers should be washed in flowing water for at least an hour for complete permanence and freedom from stains. A rubber hose attached to a faucet and then inserted into the bottom of a tray or plastic pail will allow for adequate flow of water when the faucet is turned on gently.

Less careful washing may be adequate for practice and experimental photographs.

PROBLEMS TO SOLVE WITH A CAMERA

1. Can you tell me about your family with pictures?

2. Can you record the fun your family has together?

3. Can you take pictures that fool people---that are not easily recognizable at first?

4. Can you take texture pictures, cloth, pavement, bark, ripples on water, etc? Use different lighting---morning, evening, sunny or cloudy.

5. Can you take repeating pattern pictures---fences, shadows, buildings, windows, etc.

6. Can you record data with a camera?

7. Can you record change with a camera?

8. Can you take pictures that tell a story?

9. Can you take pictures that show an emotion?

10. Can you take comparative pictures close up and far away?

11. What happens when you take pictures through cellophane?

12. Can you get interesting effects with double exposures?

Try taking indoor pictures and experimenting with a fast developer. Use a 90 second developer for four or five minutes to force the negatives.

MATERIALS FOR CONSTRUCTION OF TEN SETS OF MEASURING DEVICES FOR MICROCLIMATES

TEMPERATURE

10 Thermometers

WIND SPEED AND DIRECTION

10 Wind vanes
10 Light weight anemometers
10 Medium weight anemometers
30 Corks
10 Large needles or long pins (#7 insect pins work well)
40 Thin wires or long pins for vanes and light weight cones
30 Conical paper cups
30 Lengths of 14 Ga. iron wire for Conical cups
10 Bases — wood block, plastic cup, etc.
1 Tube "Plio-Bond" cement
20 1/2" to 1" lengths of glass tubing
Several sheets of writing paper for vanes and light weight cones
10 Extra corks if needed for bases or plastic
1 or more cork borer or hand drill (the size of the glass tubing)
1 or more wire cutting pliers

HAIR HYGROMETERS

10 Wood blocks
50 Small nails
20 Feet of 18 or 20 Ga. wire (copper or stove wire)
About 75 strands of 10" or longer hair (human or otherwise)
1 or more hammers
1 or more wire cutting pliers

SOIL MOISTURE

10 Cans or paper cups of equal size
1 or more balances or scales

LIGHT INTENSITY

1 Roll of blue cellophane gift-wrapping paper or 10 filters of other kinds
1 or more scissors
1 or more staplers
1 Generous supply of blueprint paper cut into pieces larger than the filters
10 Containers for water development of blueprint paper (plastic paint pails or ice cream containers)

MICROCLIMATES

The study of climate involves many different kinds of measurements. Each of these measures can be a study in itself. But this lesson will combine straightforward use of several simple measuring devices to show that there are variable conditions which combine to make our weather.

A microclimate is the total of weather conditions in a small local condition, such as around a school building or under a bush, as compared to the climate of a state or a mountain area.

Weather conditions which we can measure with simple devices are:

air temperature

soil temperature

surface temperature

wind direction

wind speed

humidity

soil moisture

light intensity

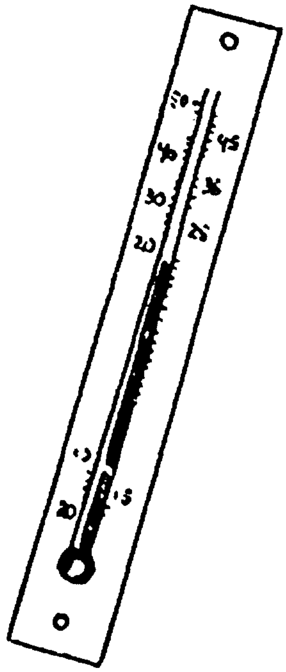
These weather conditions will vary in degree from place to place and time to time. But patterns of relationship can be found among them.

If this lesson is to be used just to measure weather once, it will acquaint students with the various conditions which can be defined and measured, some of which they may not have considered before. The object of the lesson will require several measurements, however. Each condition will be measured at different places and times, and comparison among them will be made. The lesson may require from two to three hours to two to three weeks or longer, depending upon the number of relationships you wish to explore and the interest of the students

MICROCLIMATE MEASURING TECHNIQUES

1. AIR TEMPERATURE

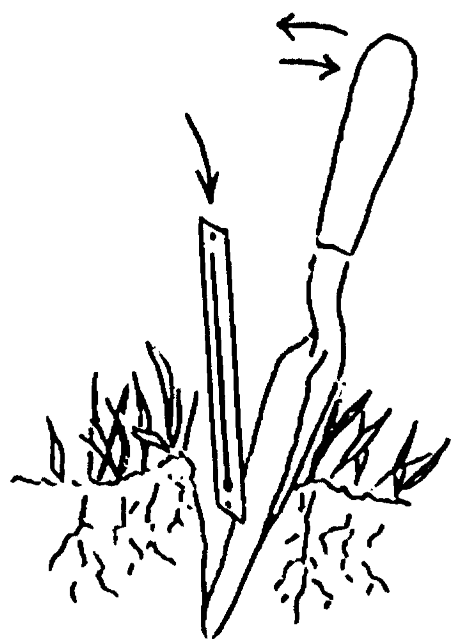
A simple Celsius (centigrade) thermometer is used. This is the temperature scale which is used for scientific measurement and will probably be used generally within the next few years. Readings are not converted to Fahrenheit. The number values are not important. The relative difference of readings is important.



When air temperature readings are taken, the thermometer should be held away from your body and in such a way that fingers do not warm the bulb. The thermometer must be shaded from the sun or the bulb will be heated above air temperature. Read the thermometer only after the indicator fluid stops moving.

2. SOIL TEMPERATURE

The same thermometer is used for soil and air temperatures. A single soil temperature at about 2 centimeters below the surface of the ground is sufficient for beginning measurement. Readings at 2, 5, and 10 centimeters depth are interesting for later comparisons.

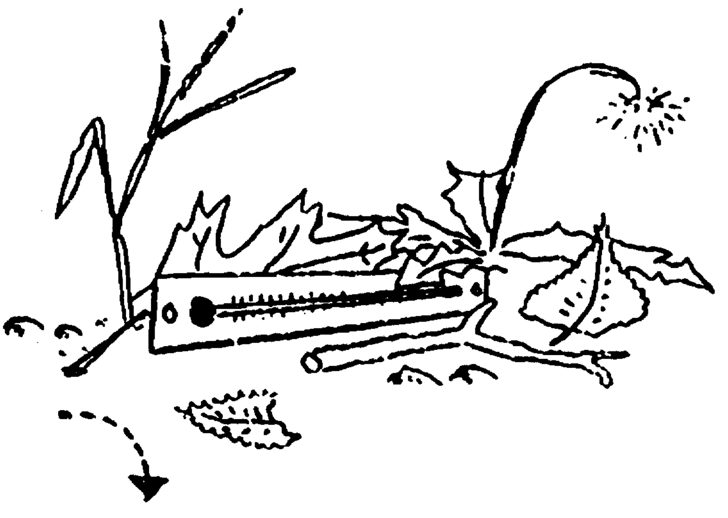


Make a slit in the soil by forcing in a trowel or table knife and prying forward. Pull the digging tool back, slide the thermometer bulb into the slit to the proper depth, slip the tool out and close the soil against the thermometer. Read only after the fluid stops moving.

3. SURFACE TEMPERATURE

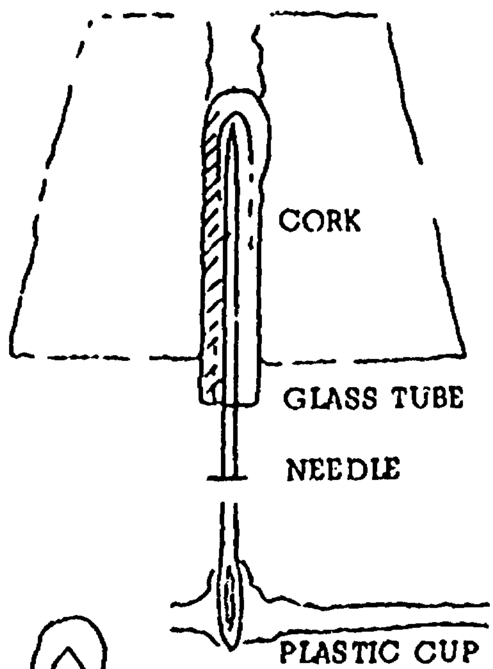
Reading the surface temperature is a little awkward. It involves getting the thermometer bulb in contact with the surface but protected from air above. Insert the thermometer upside down under the vegetation or surface material (dead leaves, etc.). Read quickly after removing.

A reasonably accurate reading of solid, smooth surfaces (such as a rock or window ledge) can be made by sticking a small wad of plasticene clay over the bulb and against the surface to be measured. If the thermometer is attached to a supporting back, this may have to be cut away at the bulb to allow surface temperatures to be taken. Read the thermometer only after the indicator fluid stops moving.



4. WIND DIRECTION

A simple wind (weather) vane indicates wind direction. A wind vane tends to waver back and forth in a breeze so an average direction must be roughly determined.

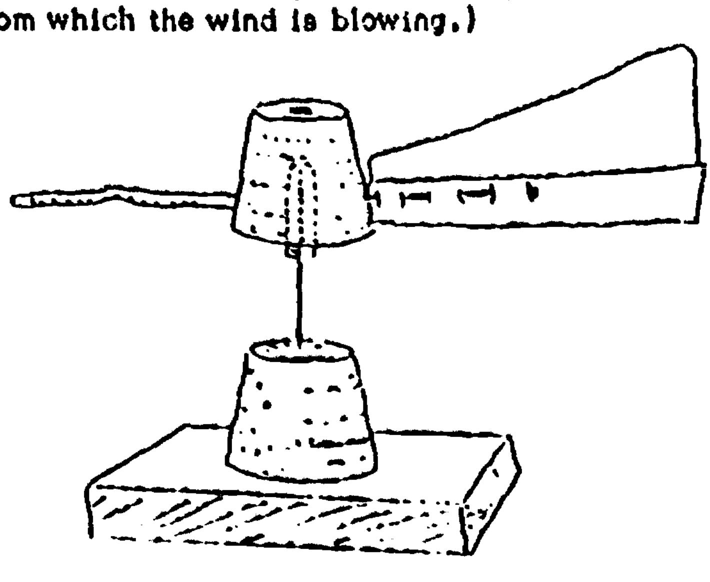


In order to get any indication of wind direction with very slight air movement it is necessary to have a wind vane which will swing with very little resistance. To reduce friction in turning, a bearing is needed. A simple but effective bearing can be made from a short piece of heat sealed glass tubing which rotates on a needle or large pin.

If you cannot make this bearing yourself by melting the end shut over a gas stove burner or propane torch, a chemistry teacher should be able to supply what you need in short order. The best bearing surface within the tube end looks like this:

Other shapes will work well enough. Cut the tube off by scratching with a file and bending away from the scratch.

Bore a hole in a cork and insert the tubing. The chemistry lab has tools for this, or you can use a hand drill. Make a vane of paper and hold it to the cork with a pin or wire. Insert a wire or other pointer opposite the vane to balance the cork on the bearing. The wind will push harder on the broad vane than on the thin pointer. This pushes the vane away and swings the device so that the pointer points into the wind. (If the general compass — North, South — orientation of the school or area is not known it may be necessary to use a compass to know the actual direction from which the wind is blowing.)



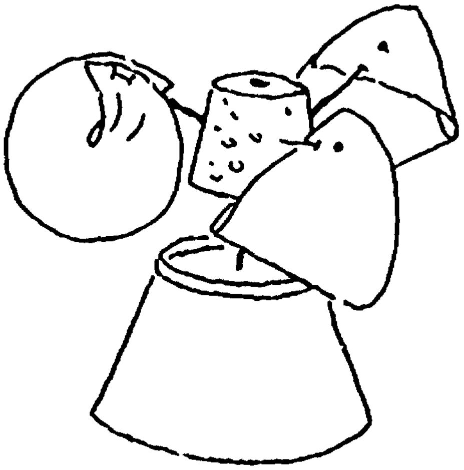
Support the bearing needle by sticking the blunt end in another cork or some other sturdy material which can be used as a stand. It is well to have a broad, sturdy stand so that it will not blow over in a strong wind. The needle may be heated with a match and heat-sealed into the bottom of a plastic cup (styrofoam is too light and weak).

Attach the vane and pointer below the point of rotation of the device. This puts the center of gravity below the pivot point (where the bearing turns on the needle point) and makes the device much easier to balance.

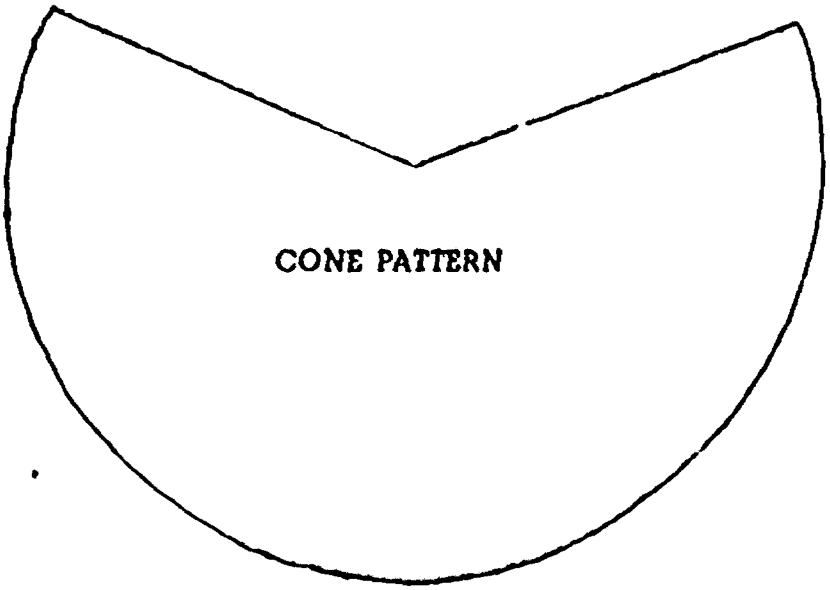
5. WIND SPEED

An anemometer measures wind speed. Another rotating device can be made from a cork and sealed glass tubing for use on the needle pivot of the wind vane.

Three Conical cups on wire arms will catch the wind's force more in one direction than the other, causing the device to rotate. The rate of rotation is a measure of the wind speed.



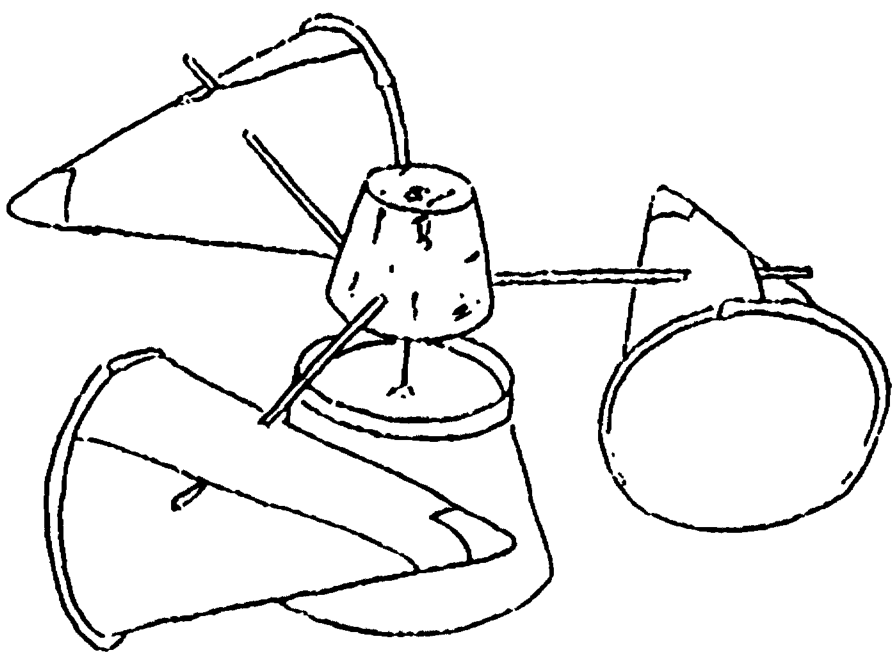
The cups can be made of paper by rolling the pattern into a cone. Writing-paper cones held to the cork with long pins makes a very light weight, sensitive anemometer which may detect air currents in a room. For use out of doors the cones must be glued to the pins at the points of contact both outside and inside the cup, and it is best to glue the pin into the cork to keep the cups from twisting out of position. Use white glue, airplane cement or plastic cement. Goodyear "Plio-Bond" glue works best on the metal.



For moderate winds use conical paper drinking cups held to the cork with stiff wire. Glue all joints. If measurements on very windy days are wanted, even heavier materials, perhaps metal, will be needed. A more rigid bearing is necessary also — perhaps a roller skate wheel or sealed shaft-bearing mounted on a stick or bolt. The rotation rates of the differently constructed and different sized anemometers are not equivalent. Readings will always have to be made in terms of the kind of anemometer unless you wish to compare them and calibrate one in terms of the other.

The anemometer must be balanced to work well, as with the wind vane. Insert the pins or wire below the pivot point of the cork and space them evenly. The wire can be bent back and forth and the cups can be slid in and out before glueing in order to get the best balance possible. The better the balance the more sensitive the device.

Paint or mark one cup so that it is easy to count the number of rotations per minute.



6. <u>HUMIDITY</u>

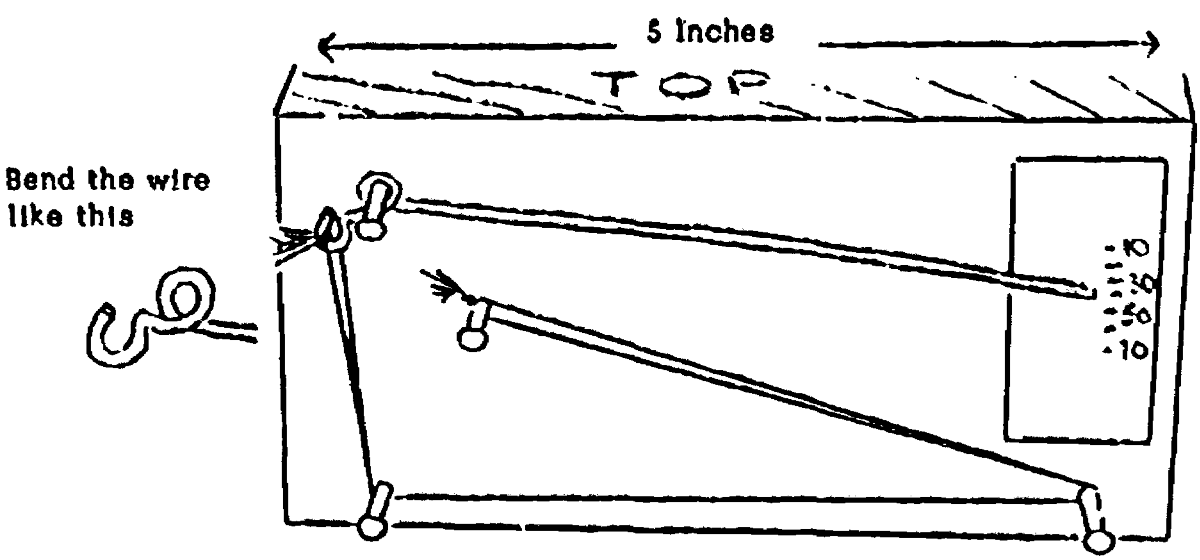
Very rough estimations of humidity can be made with cobalt chloride paper. But this usually only indicates it is humid or not — not the relative amount of moisture in the air.

An old-fashioned hair hygrometer works very well and works very quickly — within five minutes to register humidity. Any kind of hair will do — the longer the better. Hair stretches when it gets damp — shrinks again when it dries. If several strands (for strength and ease) are tied together at the ends, strung on a rigid support and hooked to a lever to exaggerate the reading, very reliable results can be obtained. The hair is wound around nails to conserve space and make the hygrometer easier to use.

Sixteen or eighteen gauge copper wire is easiest to bend into this shape. Put the nail through the loop after it is bent. Keep the loop loose on the nail. String the hair on the lever and the bottom nails first, then insert the last nail through the hair strands, pull the hair tight so the pointer is positioned properly, and then pound the nail in.

Be sure to read the instrument in an upright position. Tap on the hairs a couple of times with a pencil to make sure that the weight of the pointer is pulling them tightly each time you take a reading.

A slip of paper can be taped or glued under the pointer with arbitrary graduations for easier reading. The highest number at the bottom of the scale makes more sense to the student as this position would indicate the greatest amount of moisture in the air. Also the hygrometers can be calibrated in relation to a commercial device which reads in percent of relative humidity. Don't take the weather report's word for it; the reference hygrometer must be in the same microclimate as the one you are calibrating. For greatest accuracy each hygrometer can be calibrated separately, but if all the hairs are the same kind and the same length, the same scale for all devices will be reasonably accurate.



7. SOIL MOISTURE

For first measurements it is probably good enough to just estimate the amount of water in the soil. Students can tell by feel or observation if the soil is wet, moist, or dry. For more exact water content, a quantity measure can be made most easily by weighing.

All samples of soil taken for weighing should be the same size. A small can or paper cup can be used as both a scoop and a standard measure. Weigh the soil and the container. Record the weight. (The unit of weight is unimportant. It could be ounces, grains, paper clips, or buttons, as long as the unit is the same for all weighings.) Set the container of soil on the radiator or close under a light bulb so that the heat will dry the soil. It may take two to three days for it to dry out. If you want it to dry fast, bake it in an oven. Better use a can for this and not a plastic or paper cup. Weigh the soil and the container again after the soil is dry.

Subtract the dry weight from the wet weight and the result should be a fairly good quantitative indication of the weight of water contained in the sample. This number (the weight of water) is comparable to the other samples taken only if the other samples were the same size.

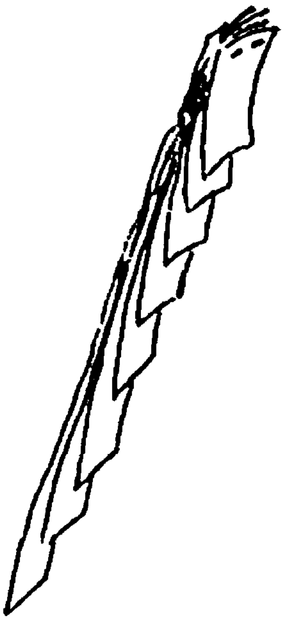
If samples vary in volume it is necessary to compute the proportion of the sample that is water, i.e. 1/8, 1/3, 10%. The proportions of water or the percent of water content is then comparable to other samples. It is not the intention of this lesson to practice this kind of math exercise, but if students wish to compute the percent of water, it is done by dividing the weight of water by the initial wet weight of the soil alone (without the can).

8. LIGHT INTENSITY

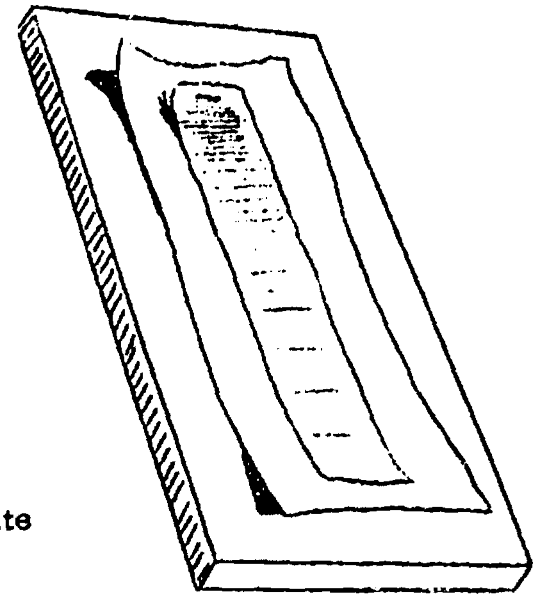
The brightness of light in a certain place, whether in the sun or in the shade, can best be made with a photographic light meter. However, it is kind of expensive to give each student a light meter.

A good substitute light meter is a light filter, graded from transparent to opaque, held against a light sensitive paper.

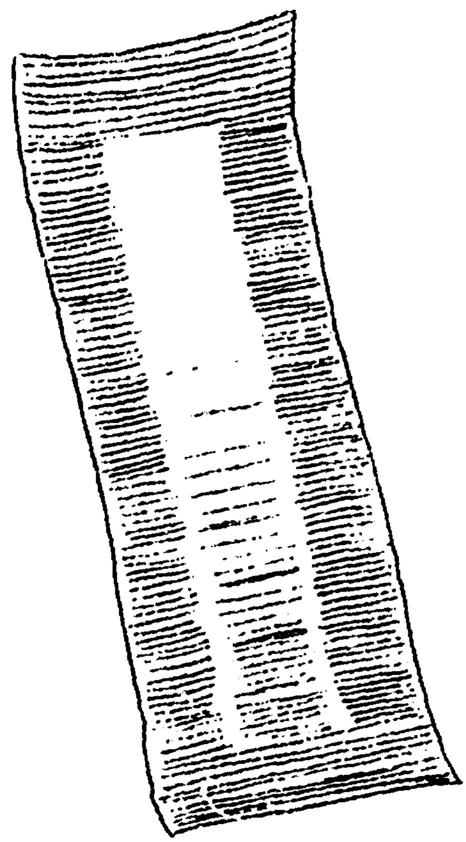
Successively overlapped layers of colored cellophane (blue is best) will make such a filter. Also a darkroom "grayscale", or a film negative which has bands of successively longer exposure before development can be used.



The filter is held against blueprint paper for exposure. Blueprint paper is sensitive to blue light but is "slow" in that it takes a lot of light to affect it. This is good. It gives the student time to fumble his blueprint paper out of light tight container, place the filter on top of it, hold the two against a flat surface (a box, a cardboard or a clipboard) expose to light for one minute (or a count of Mississippi — one, Mississippi — two, ...Mississippi — sixty) and then fumble the blueprint paper into a container (plastic pail) of water.



The quicker the "fumble" is, compared to the one minute exposure, the more accurate the reading. The "fumble" part should be shaded from the direct sun and, best, even from open sky light if possible. Hold the filter and its support parallel with the surface that is being measured for light intensity. Water will develop the blueprint paper and will fix it so that it retains the photo image. Better do the water developing in the shade for best results.



After development, the image on the blueprint paper will show the brightest light as the longest streak of dark color, the dimmest light by a short streak of dark color under the filter.

The ESC filters have numbers on them. The last readable number on the developed image is an indication of the light intensity. The higher the number the more intense the light. If you do not have numbers on your filters you can measure the length of the dark streak with a ruler or count the number of bands which have darkened.

Always trial test for the standard amount of time for which students should expose the blueprint paper on each occasion that this technique is used. Paper will age and vary in sensitivity, cloudy days will require longer exposure, and the time of year, time of day, or the latitude will affect the intensity of the light. If all students do not use the same exposure times their results will not be comparable.

Blueprint paper can often be obtained free by begging from a blueprint company. A roll 36" x 1000' can be purchased for about $28.00. You need to cut it in strips for the students to handle it. Keep it out of bright light and keep it dry. Ozalid paper or photo print paper workd, but they require more complicated development.

VACANT LOT STUDIES

Environmental Science Center
5400 Glenwood Avenue
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INTRODUCTION

A naturalist once told of an experience with a group of city children he was guiding along a nature trail. He could not understand their lack of interest when he enthusiastically announced, "Why, there's a scarlet tanager!" He concluded that a purple elephant couldn't have aroused their interest.

His testimony reinforces a growing belief among educators that children must be educated in familiar surroundings using familiar subject material.

Why should a child, surrounded by concrete and brick, become excited about a scarlet tanager? He can see more brightly colored parakeets in the dime store any day. If the guide could have staged the appearance of a purple elephant, he probably would have been satisfied with their reactions, for even a city child has been exposed to the elephant and all the fantasy that surrounds him.

The problem of meeting the city child on his own grounds seems a difficult one for the environmental educator. Where does the city environment allow demonstration of typical environmental education such as forest management, crop destruction by erosion, the hydrological cycle, or large scale species identification? The Environmental Science Center, however, finds the city a good place to fulfill its aims because old forms of environmental education have been discarded in favor of a new approach, which will, it is hoped, cause more permanent and effective change.

This new approach attempts to instill an inherent sense of ecology by actively involving the children in study of their immediate environment. Ecology, being the relationship of living and non-living things to each other and to their environment, does not exclude man.

However, man has omitted himself from the ecology of the world for so long that he has now put it into grave unbalance. E.S.C. lessons put man back into ecology, and therefore, the city -- which is dominated by man's influence -- is a study in extreme.

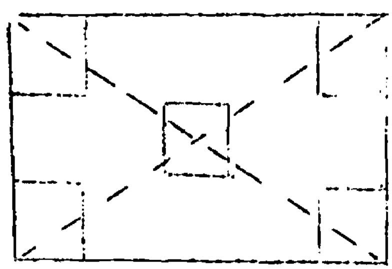
Vacant Lot Studies give the city child a chance to understand ecology without ignoring the apparent influence of man. To do this we must eliminate the artificial barriers set up between natural science, mathematics, social studies, and even economics. Ecology encompasses all of these when man is put back into the picture.

SETTING UP PLOTS ON A VACANT LOT

The vacant lot studies are made more manageable if the lot is divided into 12 ft. square plots and each team assigned a plot.

The width of city lots usually runs from 40 to 115 feet wide. The depth of lots varies even more than the width. If five 12 ft. square plots are placed on the lot and studied you should get a sampling of what can be found there. On larger lots several more plots might be added to these five without crowding the teams. Try to arrange one plot for each team.

To locate the plots on the lot imagine a large "X" has been drawn across the lot. Locate one plot where the "X" crosses, and one near the upper end of each leg of the "X"



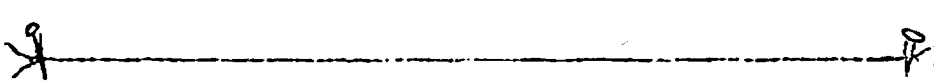
If more than five plots can be placed on the lot these may be located at random between these basic five plots.

Provide each team:

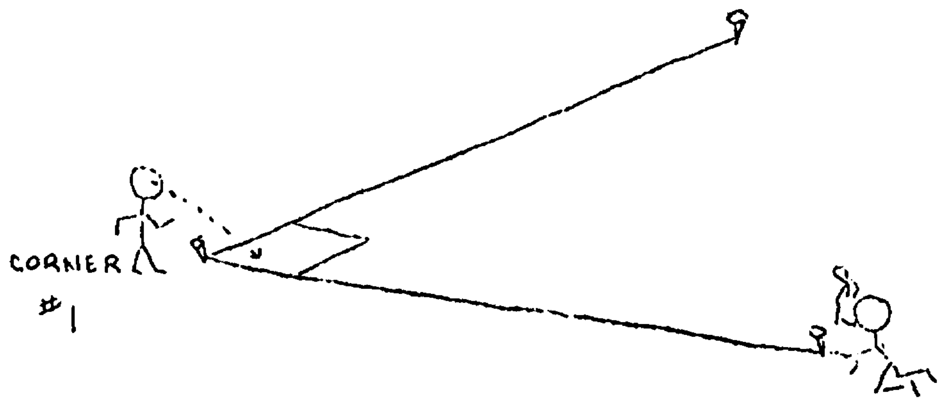
1. A 48 foot length of string knotted at 12 foot intervals.
2. A square of cardboard, 12" in size.
3. Nails -- 10 penny

Your class's first problem will be to enclose a 12 ft. square and make it really square! A little practice on the school ground will prevent trampling of the lot. Let them struggle with the problem for awhile. If the team combines its wits and the materials they've been given, they should solve the problem in the following way:

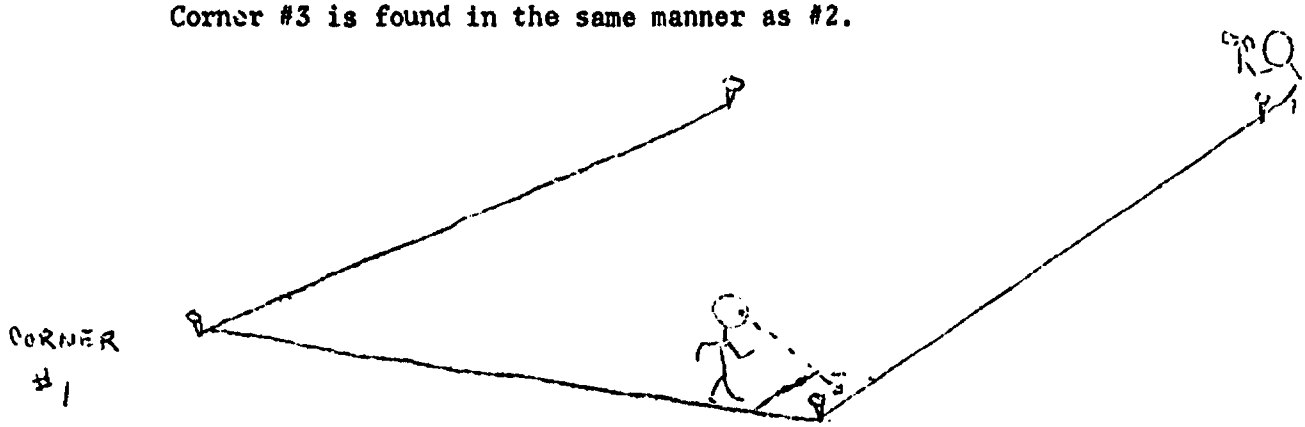
The first 12 feet of twine can be tied and spiked down as a starting line.



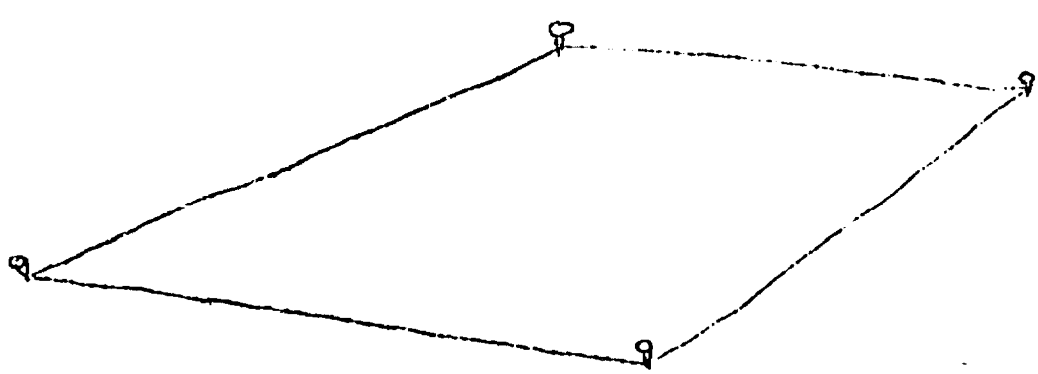
The twine is pushed snuggly to the ground. The square cardboard is laid beside this rope with one corner of the cardboard touching the spike. One team member remains at corner #1 and directs the corner #2 team member to the correct spot for corner #2. He does this by telling the corner #2 team member to move right or left until the twine he is holding is exactly parallel and snuggly against the edge of the cardboard. The rope is staked down at the second 12 foot knot.



Corner #3 is found in the same manner as #2.



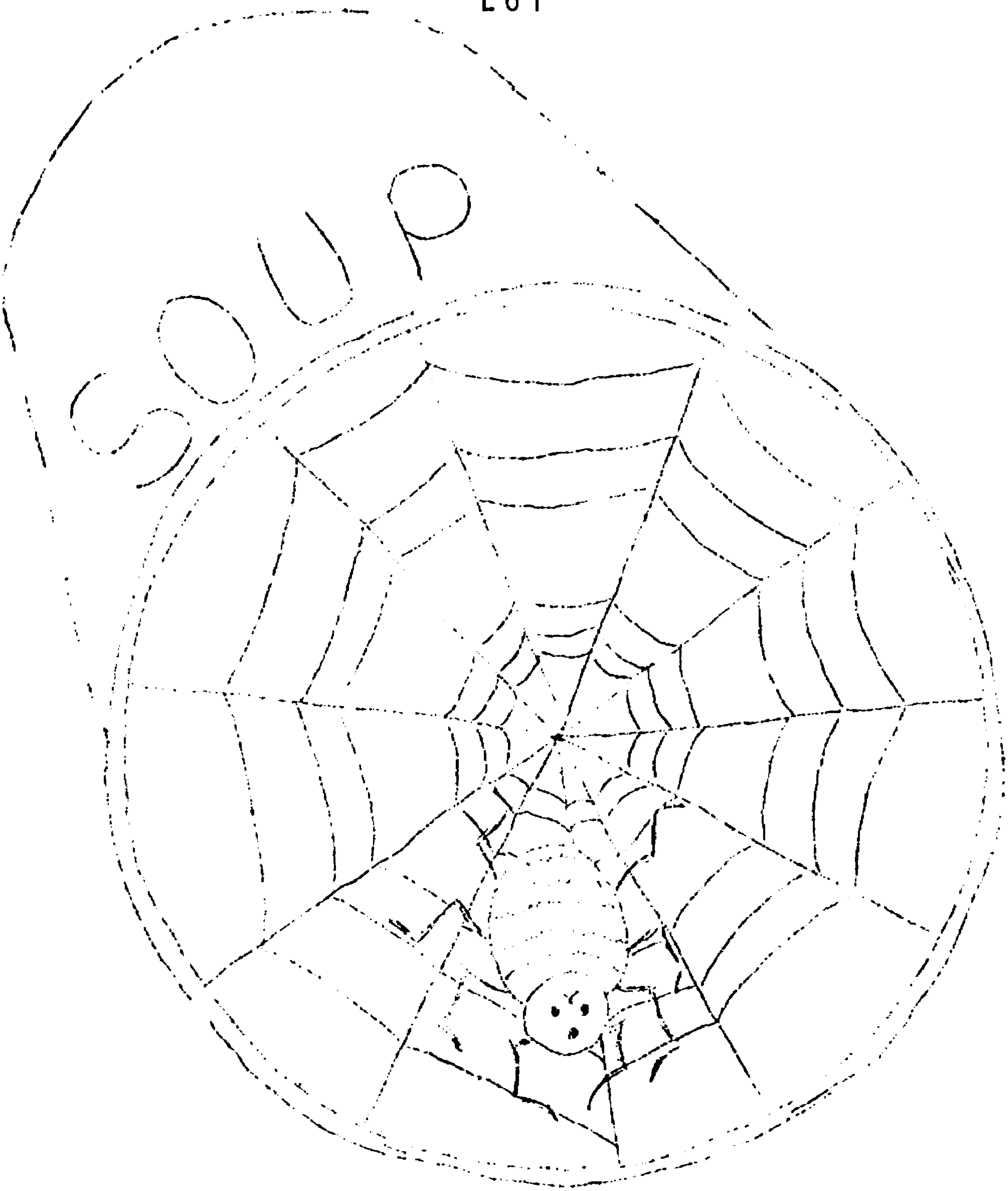
Corner #4 is the "proof of the pudding." If all corners are square, the remaining 12 foot twine should reach exactly from corner #3 to corner #4.



If it doesn't reach, the children must carefully recheck each corner to find their error. Some corrections they might make to reduce their errors are: push the twine down the spike until it is snug against the ground; pull the twine taut between spikes; make sure the point of the corner of the cardboard is against the spike.

Now each team can conduct the following studies within the boundaries of their own plot. As the group leader or teacher you should continually encourage the teams to compare and contrast their plots and the data they gather. Data sheets are included for each activity. Comparisons between plots are often more meaningful if a map has been prepared and the location of all information recorded on the data sheets plotted on the map. Instructions for developing maps of the plots are given in the Appendix. Mapping of the data will be suggested in some of the individual activities. Mapping is highly recommended for all of the activities, however.

LITTER AND THE LOT



A vacant lot often presents a good study of man's ability to litter his environment with refuse. Obsolete and worn out "crud" ranging from bits of paper to old bed springs and junk cars often find their final resting place in a vacant lot. Living plants and animals on the lot often depend upon or are affected by the litter.

In a vacant lot, children can see the relationships which have developed between man, his litter, and the plants and animals of the lot. To allow for later studies, ask the class to always replace any object you might pick up.

Litter changes the environment in many ways, such as cutting out light, increasing moisture, introducing materials into the soil, providing support. Ask the children to try to imagine what the vacant lot would be like without the litter. Your class will probably find examples of adaptations caused by litter.

For example, a pigweed rooted in the soil but growing over a sheet of tar paper does not have to compete with other plants. A plant rooted in a small pocket of soil in a brick doesn't seem to grow elsewhere in the lot. A plant, leaning to grow around a board which is shading it, looks quite different from its brother growing in full sunlight. Children might find plants and animals depending upon litter for support (vining plants), for increasing moisture (slugs, sowbugs, earthworms), for eliminating light (moss, mushrooms), and for other reasons.

Decomposition can be seen in old boards and vegetative wastes. These rotting materials will change the composition of the soil in this spot.

The data sheet on the following page will help the children direct their investigation. Discuss the terms environment, depend upon, related to, and affected by as they are used in the data sheet. The students might complete several data sheets for one piece of litter.

DATA SHEET

name ______________________

The Relationship

Draw a sketch showing the litter and the living thing you think might depend upon or be affected by the litter. Try to show how they are related to each other.

The litter	The living thing
Describe the litter: __________	Draw a sketch of just the living thing;
______________________________	if it is a plant, tape a leaf next to
______________________________	the sketch:
List ways it might be changing the	
environment around and beneath it:	
______________________________	
______________________________	Describe how it depends on or is affected
______________________________	by the litter: ______________
List any evidence that the state-	______________________________
ments on your above list are true:	______________________________
______________________________	______________________________
______________________________	______________________________

WHO'S BEEN VISITING OUR LOT?

I. Burrows

Check the plot carefully for burrows and tunnels. Examine: (1) the base of fences; (2) cement blocks, bricks, large stones; (3) hollows, ground depressions, sides of banks; (4) tree roots, and clumps of vegetation; and (5) under matted grasses.

Measure the diameter and make notes on the appearance of a burrow. Locate and count all similar burrows found throughout the plot. Are they all found in the same kind of surroundings? Map the locations, if desired. See the Appendix for instructions on mapping.

II. Droppings

What animal droppings can be found on your plot? Do dogs leave droppings there? Do they use one particular part of the lot, or all of it? If one part of the plot seems to be used heavily, study its characteristics. Can you explain why this section is used more heavily than other sections? Have you seen dogs using this spot?

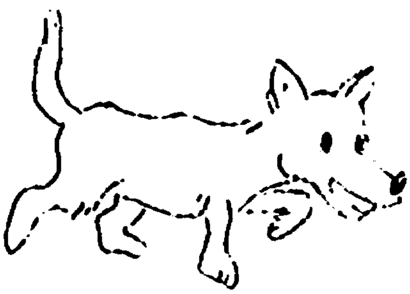
Check around the entrances of the burrows you located. Can you find any droppings? Why might an animal come outside to defecate? If the droppings are small and dry, collect some in a plastic bag and label them with a description of the burrows found nearby. Are the same droppings found near other similar burrows? Does this evidence provide clues about what kind of animals live in the burrows?

Do rabbits come into the lot? Their droppings are black-brown, round and pea-sized. Collect some of these in a plastic bag. Label them (always say where you found them).

Look on the tops and sides of fences, boards, rocks, broad leaves, and other flat surfaces for bird droppings. What seem to be favorite perching areas? What reasons might a bird have for choosing a particular perch? (Safety? Food?) Watch these perches to observe the birds which frequent them.

III. Other signs of animals in the lot

CATS: Why might a cat visit the lot? What implications does his presence have for the rest of the animal life in the lot?



BIRDS: Why do birds visit the lot? Are there trees or bushes for nesting? Weed seeds, berries, or insects for feeding? Can you find bird nests or observe birds feeding? If there are different kinds of birds in your lot, do they have different reasons for being there? Watch them closely and see what they do when they come to the lot.

RABBITS: If you found rabbit droppings, you have found evidence of their presence on the lot. Can you find any trails which might have been made by rabbits? Rabbit trails are usually in deep grass, about four inches across, matted, and contain droppings.

Can you guess where the rabbit is going when he makes the trail? Why do you think he's going there? Mapping instructions in the Appendix might be adapted to map these trails.

TRACKS AND FOOD: With the children's help, prepare a list of foods which might be eaten by animals that visit the lot. Each child can bring some of the foods from home. Place these foods not closer than three to four feet from each other. Around the bit of food, sprinkle (1) dry, fine, powdered soil, or (2) flour, or (3) unscented talcum powder. Either of the latter two might repel visitors to the food or they might eat it!

(4) A fourth method which is the most effective and also the most difficult to prepare is smoked paper. Shelf paper held over a burning candle collects carbon from the smoke. The soot records anything that touches its surface. Smoked paper is sometimes too effective for it records everything from insect tracks to seeds and material blowing in the wind.

Check the bait as early as possible the next day. Which food was eaten? Were footprints recorded? Try the same setup two or three times for conclusive results. Foods which might be used are: raw meat to entice dogs, cats, rats, shrews, and scavenger birds and oatmeal or peanut butter for attracting mice, moles, shrews, rats, birds and possibly cats and dogs. Any insects which might collect in and around the food could also be studied.

FIELD MICE: Field mice might be living in the vacant lot you are studying. A field mice population is almost certain if the lot is low and moist with dense vegetation.

Look carefully for runways which honeycomb the ground surface just below the matted vegetation. Look for entrances which look like round holes or separations in the vegetation. Follow runways by carefully parting the vegetation. Droppings, nests, and entrances to underground tunnels will be found along the runway.

If there is snow on the ground, it is sometimes easier to locate runways. The best snow conditions for investigating runways are found during early spring when the snow has melted to about two inches depth with a crust on top. The raised outline of runways can often be seen on the surface of the snow. The entrances are round holes or cracks in the snow. After a fresh snowfall you might even see mice tracks across the surface of the snow.

Use a small garden trowel to remove the snowy roofs from the runways. For recording, use clipboards or paper tacked to a board. Place droppings and nests found along runways in plastic bags and include in the bags a description of where you found them.

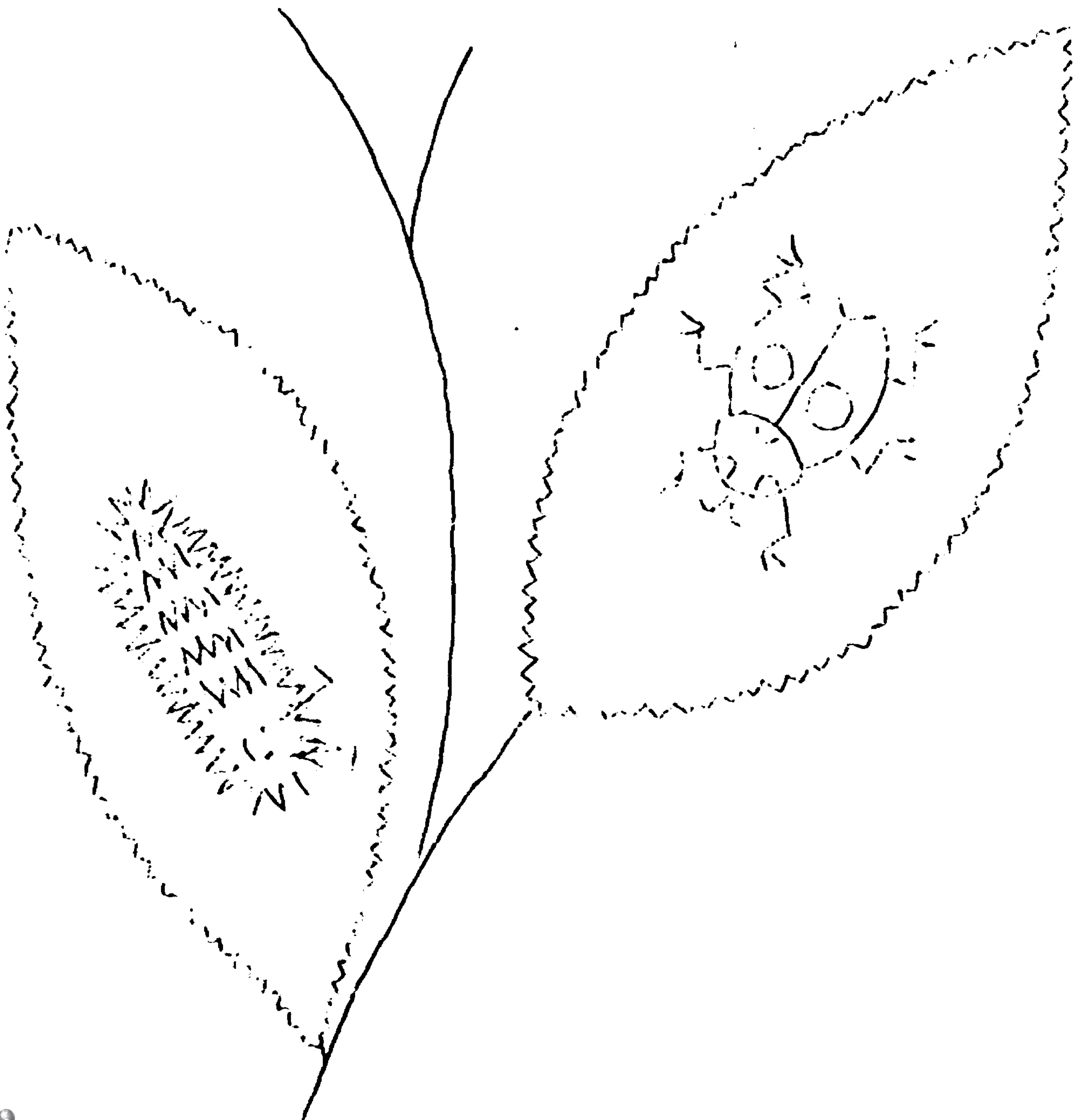
Warn the children not to trample the area, but to sit down and carefully begin to examine the area without disrupting it.

Field mice runways can be mapped easily by children using a grid system -- or graph paper. See the Appendix if you need mapping instructions.

"BUGS": Select one or more of the following means of trapping insects and other things that crawl, creep or fly through the lot.

(1) Water and detergent trap: You will need soup or juice cans three-fourths full with water. A drop of liquid detergent reduces surface tension so insects sink when they land on the water surface. Some of these cans should be buried level with the ground surface to catch walking insects. Others should be placed at random around the plot.

(2) Sticky traps: Fly paper cut into squares makes a good trap to fasten to leaves, tree trunks, and other difficult places.



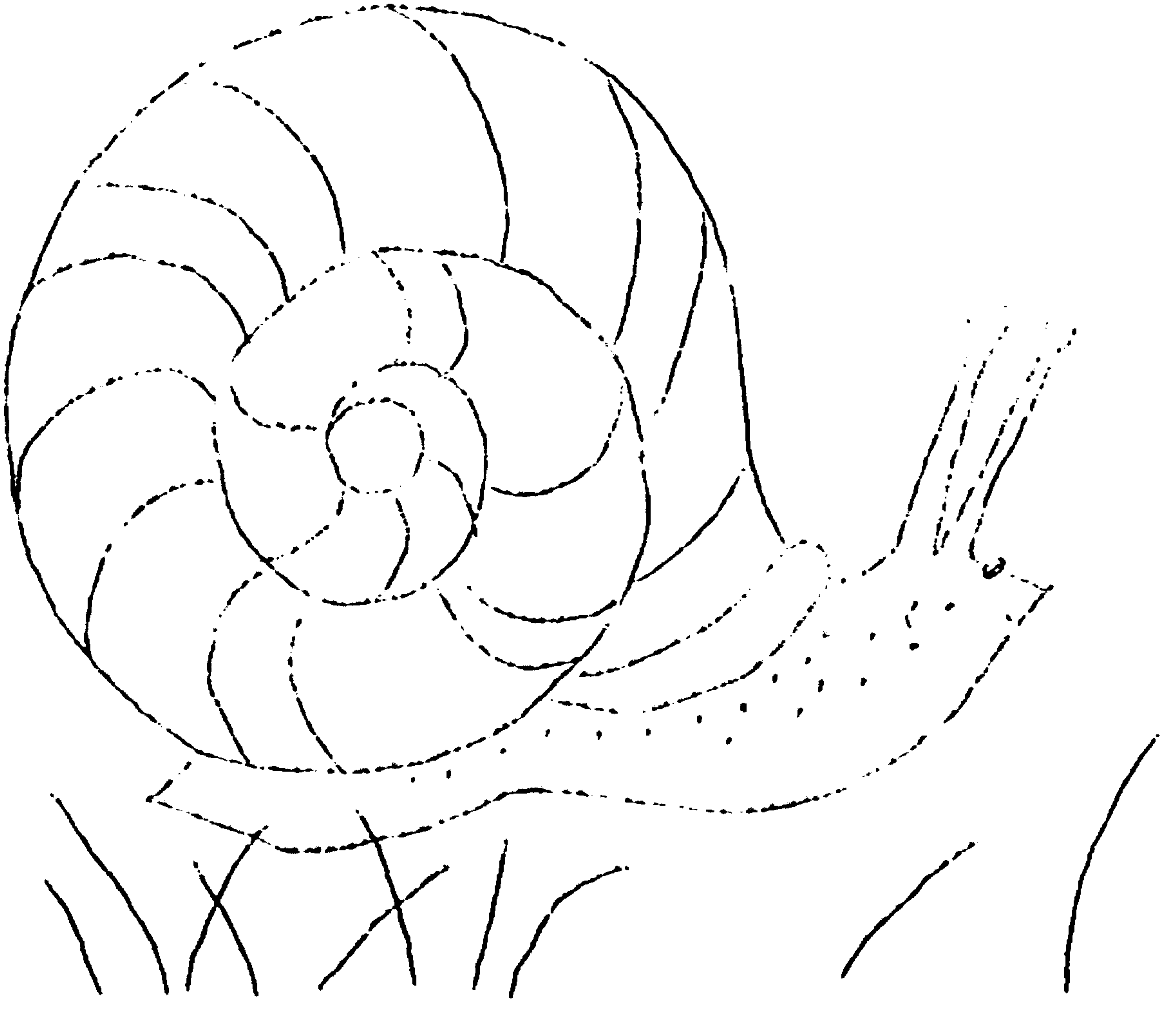
(3) Plaque traps: Set tiles or flat boards at random around the lot; check them after one or more weeks. Ground surface bugs, such as sowbugs, millipeds, and slugs might have taken up residence. Rocks and other materials already in the lot might also yield these bugs.

(4) Careful observation: Look on the ground and under things, on trees and leaves and every place you can think of. Draw the insects or kill them in alcohol.

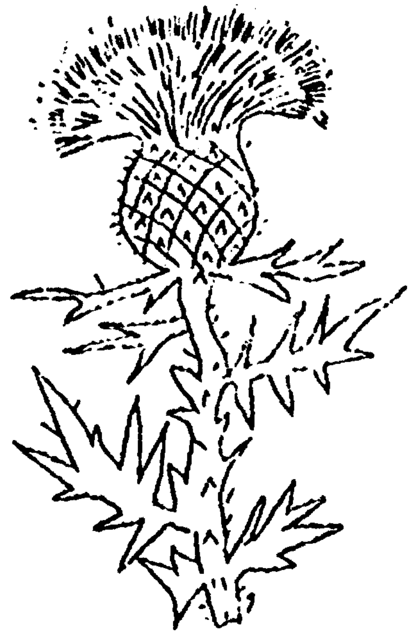
(5) Insect nets: Swing an insect net so it brushes the surface of the plants in your plot. You will be surprised at the insects you didn't know were there! Practice will make you even more successful.

Use the Appendix for instructions on mapping trap locations and resulting insect locations.

Mount the catch by placing a drop of white liquid glue on cardboard. Set the insect on top of the drop and gently settle it into the glue. The glue will dry clear making the insect visible.



PLANTS IN THE VACANT LOT



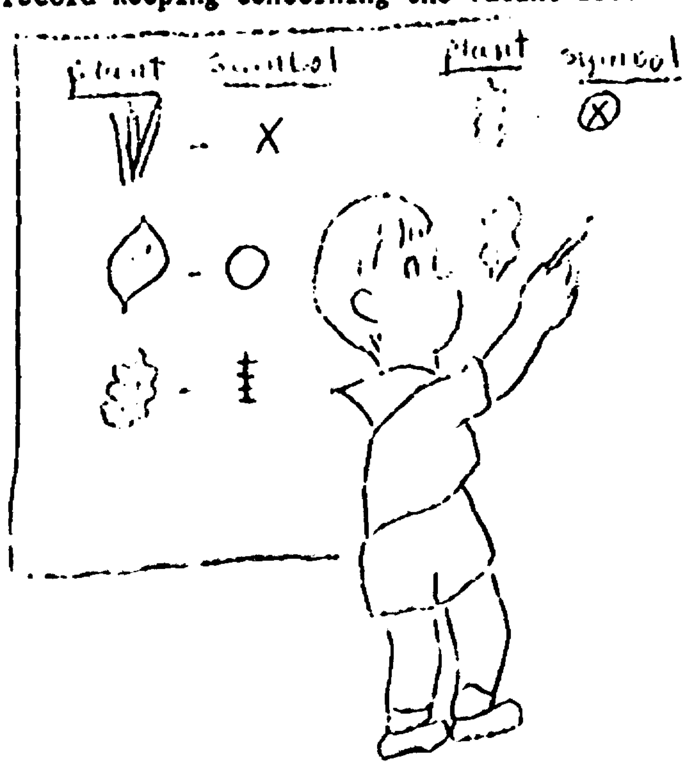
I. Variation in Plant Types

Vacant lots usually contain a great variety of plant types. The children can survey the types of plants by forming a plant key as described below.

FORMING A KEY: Select one of the following three methods--

METHOD 1. Each team should search its plot and select one sample of each type of plant. These plants should be taped to a large sheet of paper which is centrally located.

On this central key, only one sample of each plant type can be used. The child who brings the first sample of each plant type should invent and draw a symbol to represent that plant type during all future studies, mapping, or record keeping concerning the vacant lot.



METHOD 2. Repeat Method 1, but collect two plants of each type. The second plant should be pressed under heavy books for two weeks. It can then be used to replace the plant on the key which, by this time, will be wilted and misshapen. Dried plants will last longer if protected with a sheet of plastic.

METHOD 3. Repeat Method 1, except when a selection of one plant of each type in the lot has been completed, make blueprints of the plant. Return to the classroom to do this.

Remove the plants from the paper and divide the plants to be printed among the students. They should have blueprint paper inside a dark folder (so light cannot penetrate) and a bucket of water. The blueprint paper is placed on cardboard, the plant placed on the blueprint paper, and transparent plastic over this. The apparatus is held facing the sun for a time period ranging from one minute in bright sun to five minutes on a cloudy day. Expose the blueprint at a window facing the sun or take the apparatus outside. When the proper exposure has been made remove the blueprint paper and quickly dip it in water to fix the print. Overhead projectors will substitute for the sun if necessary.

The prints, after drying, are mounted and assigned symbols. A uniform key should be used for all maps. Plant samples can be taped to the key beside its blueprint.

Blueprinting the plants makes the key more permanent. It is also fun for the children to make the blueprints. The blueprinting process could be expanded into an art project. Some very beautiful effects can be attained using the blueprint paper.

A variety of plant types will probably be found within the lot. Some possible ones are listed below. It is not necessary that the children be able to name the plants for this study. A simple pictured "weed" key can be obtained from the library for your own information if you feel it necessary. One of these is How to Know the Weeds by H. C. Jaques, Brown Co. Publishers, 1959.

clover
plantain
oxalis
white campion
climbing night shade
deadly night shade
dandelion
lamb's quarters
wild rhubarb
nettle leafed goose foot
foxtail
yellow goat's beard
wild grasses
golden rod
shepherd's purse
thistle
wild carrot
milkweed
pigweed

Other plants which might also be found are seedlings from trees surrounding the lot and domestic flowers from gardens.

II. Variation in One Plant Type

A single plant type will vary in height, maturity, size of leaves, and other characteristics depending on its location in the lot. The children will notice this and will probably give reasons for these variations. They may observe that one plant in a species is larger and more healthy looking in shady areas of the lot than it is in sunny areas of the lot, or vice versa.

Take advantage of these observations to lead the children into a more quantitative study of these variations. For example, you might ask "Exactly what is the difference in size between those in the shade and those in the sun?"

Many problems are encountered during a plant variation study. The correct number of samples must be determined; the correct spot for sampling must be selected, and all contributing factors must be considered (not just the amount of sunlight). The following activities are concerned with collecting some valid data on variation occurring in one plant type.

Select a single plant type which shows some obvious variation and is distributed through many plots. Variation might be size of the leaf, amount of ground over which the plant spreads, height, or any of several other characteristics which the children have already noted as obviously varying in a certain type of plant. Decide on only one characteristic to study. Each team will be responsible for sampling the study plant and measuring the variation within their plot.

A. Sampling the study plant

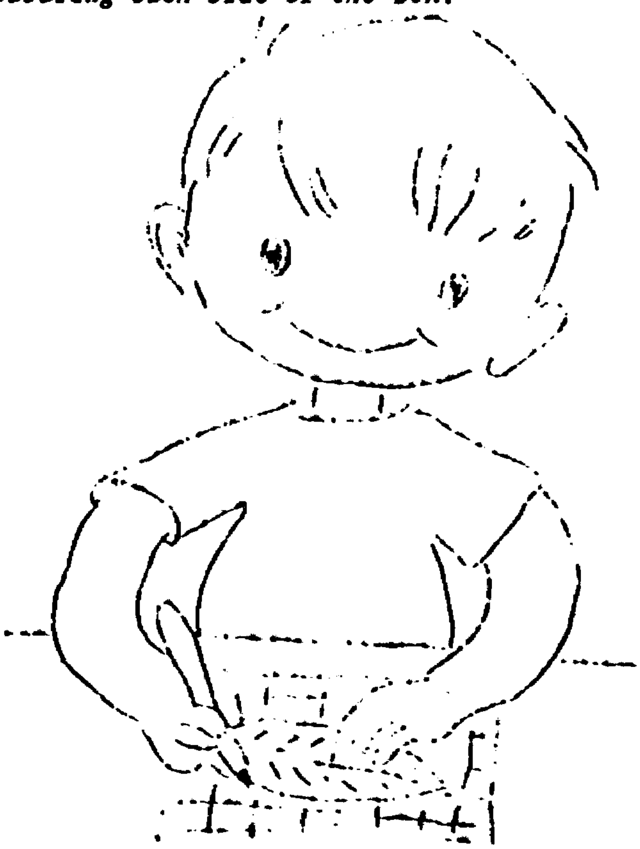
The plants selected for measurement should be selected at random because if you look for certain plant variations, you might tend to look for plants that exhibit extremes of the variation you are measuring. You might select those that are quite tall or quite short without realizing you are doing so.

Try to reach a group decision about the best way to choose five plants at random. The children might close their eyes and feel for the plants; they might toss a ring or some object and see if it lands touching a study plant type; they might cross two strings from corner to corner on their plot and measure only study plants which touch the string. Your class will probably suggest countless inventive ways to sample their section. Choosing a random sampling method might be a pencil-and-paper exercise done in the classroom because more unbiased sampling methods seem to be produced when planning is done in another location.

B. Measuring the variation in the study plant

After the study plant has been selected and its varying characteristic identified, begin a class discussion about how to measure variation. This is necessary because everyone must use the same measuring technique to produce valid conclusions.

For example, the height of a bushy plant must be measured from the ground to the topmost branch, the size of the leaf might be measured by counting the number of squares covered on graph paper for an average number of leaves, the amount of ground covered might be measured by boxing in the plant and measuring each side of the box.

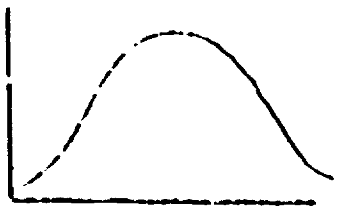


Following the sampling method decided by the class, the children should select four study plants from each plot and measure the variation using the measuring method decided upon.

Do any patterns appear? Are short study plants generally found in one plot while tall study plants are found in another? Are plants with large leaf area found more in one plot than another?

Try the same procedure with one or two more plants exhibiting different variations. Data sheets similar to these on the following pages are helpful. Remember, area and height aren't the only two variations you might study. Mapping procedures described in the Appendix might be adapted to map variations thus giving the class a more complete picture.

In addition to measuring variations, the children can graph these measurements. Area of leaves, height, diameter of stems, etc. can be easily graphed. A graph composed of class results for one kind of measurement will show a curve similar to a normal curve if the number of plants measured is large enough. You may be familiar with the normal curve as shown by I. Q. distribution.



These activities will arouse curiosity about why variations occur. Discuss some theories. If they suggest things such as amount of sunlight, soil moisture or soil type, they can make observations to help confirm their theories. Simple tests for environmental characteristics like these can be found in E.S.C. transect studies.

DATA SHEET

Plot ____ Variation in area of plant with symbol ________

SAMPLE PLANT 1.

area of first leaf ________

area of second leaf ________

area of third leaf ________

area of fourth leaf ________

area of fifth leaf ________ Ave. area of leaves ________

SAMPLE PLANT 2.

area of first leaf ________

area of second leaf ________

area of third leaf ________

area of fourth leaf ________

area of fifth leaf ________ Ave. area of leaves ________

SAMPLE PLANT 3.

area of first leaf ________

area of second leaf ________

area of third leaf ________

area of fourth leaf ________

area of fifth leaf ________ Ave. area of leaves ________

SAMPLE PLANT 4.

area of first leaf ________

area of second leaf ________

area of third leaf ________

area of fourth leaf ________

area of fifth leaf ________ Ave. area of leaves ________

III. Plant Succession and Seasonal Change on the Lot

The natural change in plant population that occurs over time is called succession. The extent of succession that occurs on a lot during one year depends on when and how the lot was cleared. A lot cleared by bulldozer during the fall or summer preceding your study will show a high degree of succession.

A lot which has been vacant for several years will show less evident succession. Identification of succession on such a lot might not be too apparent to all members of the class. However, a study of succession during different times of the school year is beneficial, whether or not the lot has been cleared recently, as seasonal change occurring in the lot is often dramatic.

The most effective way to study succession is to complete separate vegetation maps for fall, winter, early spring, and late spring. Follow mapping instructions in the Appendix.

Classes during following years will see a broader picture of succession if they can refer to maps and records saved from earlier classes. A very thorough study of succession could result from the survey of a vacant lot for several years after it is cleared.

To make a vegetation map of the lot: (1) make a plant key; (2) decide on a method of estimating numbers of plants so the class won't have to count each one; (3) and map vegetation types.

1. A PLANT KEY can be prepared using one of the methods found on page 14, Variation in Plant Types.

2. ESTIMATING NUMBERS

   Encourage each team to devise a key for estimated numbers of plants in their plots. Obviously, it would be a tedious job to count them all. Then, during class discussion, select the best key. This key should show individual plants, small groups of plants, large groups of plants, and those that completely cover a patch of ground. One uniform key should be used by all teams.

   Your key might be similar to the following:

   1-2 plants = red
   3-10 plants = blue
   11-20 plants = green
   thick cover = yellow (crosshatched)
   bare ground = blank (white)

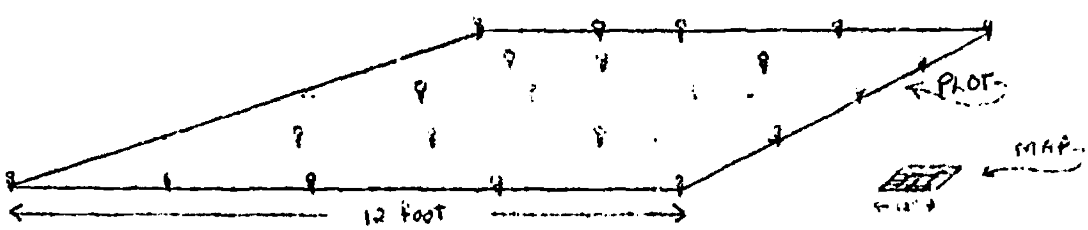
A plant is recorded on the map paper by drawing its symbol from the class key. Use the color which represents plant population density. In the case of thick cover, use yellow crosshatching and draw the symbol for the prevelant plant type in yellow on top of the crosshatching.

3. MAPPING THE VEGETATION TYPES

Each group can map the types of vegetation in their plot by using the grid method. If you feel your class needs some preliminary work in grid mapping before mapping the plot, refer to the Appendix.

Each team should have string, spikes, and 12 x 12 mapping sheets with cardboard backing. Mapping sheets can be made by trimming 12 x 18 inch drawing paper to 12 x 12 inch dimensions.

a. Each team should grid its 12 foot square plot into three foot squaro sections. Yardsticks and ropes aid in setting up the sections. Mark the corners of each section with a spike.



b. Place a flag or mark of some type on one corner of the plot. The first section in this corner is number one. All other sections are numbered consecutively through twelve.

c. Each group grids their 12 inch square map paper into three inch square sections. These sections are numbered one through twelve to correspond to the sections of the plot.

d. Using the grid as a guide draw in all thickly covered areas with yellow crosshatching, described on the previous page.

e. Draw the symbols for all other plants in the correct sections using the color which shows their density. If they fall within the crosshatched area, draw their symbol on top of the crosshatching.

When the map is complete, start a group discussion about similarities and differences between plots. The children might compile a list of plants which are found in all plots, plants which are found in most plots, and plants which are found in one to two plots. These comparisons can be made for all the plot maps of one lot. Comparisons can also be made between lots, if your class is studying more than one vacant lot.

Allow enough time for a complete discussion of similarities and differences. Discussion will probably stimulate thinking about why plants are distributed in certain ways and man's involvement in this process.

Repeat the mapping procedure several months later. Do the maps turn out the same as the ones made earlier? Has there been change in the pattern of vegetation? Have some plants appeared that weren't there before? Are bare spots of earth being covered over with plants? What kinds of plants first move onto bare spots? Have some plants moved into plots they weren't in earlier?

Repeat the mapping procedure a third and possibly fourth time at intervals of several months.

THE COMMUNITY AND THE VACANT LOT

When the class has completed its studies of the animal and plant life on the vacant lot, it might question how the vacant lot affects the community.

What does the community know about the history of the lot? What feelings do neighborhood people express about the lot? What should be the future of the lot? What stories are told about the vacant lot? How is the lot used by members of the community? Is it used as a dump, playground, baseball field? What might be done with the lot to make it a more valuable part of the community? Should it be used for a mini-park, an apartment house, a grocery store, a swimming pool? To answer many of these questions, your class should talk to the neighbors.

I. Interviewing Neighbors

Discuss ways to tap community opinions. Suggest using a questionnaire, and then divide the class into groups to discuss what can be learned about the lot from the neighbors. Ask each group to prepare a questionnaire which might be used to learn these facts when interviewing a neighbor.

Each group can transfer its draft of a questionnaire to a large sheet of butcher paper, using large printing with a black crayon. Hang the questionnaires along the front of the room where everyone can see them.

Work with the class to make a composite questionnaire using the best features found in each draft. Roll playing reactions people might have to certain questions could be used at this time.

Below is a sample questionnaire. The interviewer circles the answer which is part of the question.

Sample Questionnaire

I'm from ______________________________ School. We are making a study of the vacant lot. Would you answer a few questions about the lot for us?

1. Was there ever a building on the lot?
2. What kind of a building was it?
3. Was the building (a) two-story or (b) one-story?
4. Was the building and yard (a) well kept? (b) fairly well kept? (c) poorly kept?
5. Was the building in use until it was torn down?

   (a) Yes (b) No
6. If not, for about how long was it unoccupied before it was torn down?

   (a) less than six months (b) about a year (c) about two years (d) more than two years
7. Did it deteriorate in this time?
8. Do you know how the house was removed?

   (a) burned (b) torn down by hand (c) torn down by machines (d) fell down by itself and debris were removed later (e) other
9. Do you know why the house was removed?
10. How do you think the lot might be used to benefit the community?

    (a) parking lot (b) playground (c) store (d) home (e) dump (f) other

When a good questionnaire is ready and all the children are thoroughly acquainted with it, begin to plan interview techniques.

Go into the community with one-third of the class at a time, if possible. Leave the other two-thirds in the classroom with an aide. Plan to interview people in all the houses and apartment buildings on the block containing the vacant lot. If the whole class is using the same lot, the homes should be divided among each third of the class.

Try to plan your survey so that each child will have a chance to conduct at least one interview.

A child conducting an interview at a certain location can establish contact simply by knocking on the door or, if names of the neighbors are known, by phoning for an appointment.

Keep each child within sight during the interview. Instruct the children not to enter any house.

II. Tabulate Results

As interviews are completed, questionnaire results can be displayed and tabulated on a class data sheet:

Sample Class Data Sheet

Question	Total number for each answer					
	a	b	c	d	e	f
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						

III. Evaluate the Survey

When final tabulations are finished, try to evaluate the survey. Discuss any shortcomings of a questionnaire which became apparent.

Encourage the children to contribute observations and thoughts they had or situations they encountered during interviews. Were there any stories about the history of the vacant lot? Was there any controversy connected with the lot --its being called an eyesore or feelings that the building shouldn't have been torn down? These questions might be investigated further by your class if interest is shown.

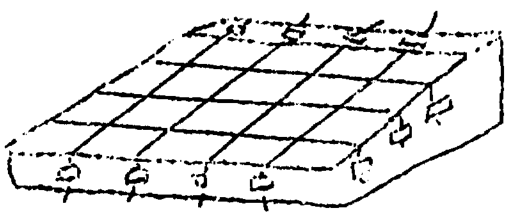
Can your class reach any conclusions about the vacant lot and its past--present-or-future uses on the basis of the survey and its evaluation?

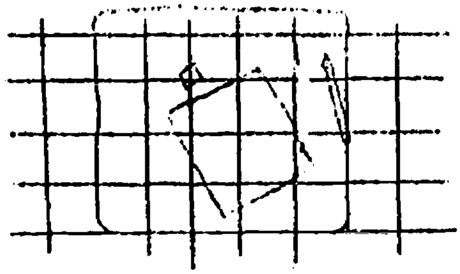
Your class might want to send a report of its survey, and any recommendations it might make, to some interested person or groups in the community--the Mayor, the Lion's Club, the Park Board, the Building Inspector, the local newspaper.

APPENDIX

A grid system gives children a wonderful tool for mapping. A desk top map with four inch grid can be made across each child's desk with string and masking tape. Cut string to extend across the width and length of the desk. Space the string four inches apart going in both directions. Anchor the string pieces with masking tape along the side of the desk.

Place several items (pencil, book, eraser, etc.) on the desk in random fashion. Use one inch graph paper to draw the map of the desk top and the items on it.





It will be very natural for you to "teach" the children to identify each space by placing numerals or letters along the sides of the grid. However, if you do not teach this method of numbering, it probably will be invented by those who need it. Children who do not need direction should not have a chore type task imposed upon them. When they discover a need, they will make use of the system you suggest or devise a better one.

When the children complete their grid maps their results will show accurate size and spacing relationships.

Now, try the same map using a smaller grid, one half inch. With most classes it is best to reproduce the same map so the idea of scale is obvious.

By now the children should be able to draw the representation of an area using a grid, numbers, and different size scales.

The next mapping experience can be a table top map, in which the children plan a three dimensional setting establishing a grid and mapping on different size grid papers.

Using a table top or the floor, lay out the neighborhood around the school with tape to designate streets, and blocks or cardboard for houses and buildings.

If your classroom has a tiled floor, take advantage of its built-in grid. Large tiles could represent one square block; smaller tiles can be grouped together to represent a block.

Landmarks, such as churches, schools, libraries, etc. can be designated with cardboard structures.

Next, the children can map their classroom using a real grid or imaginary grid. To establish a real grid the class will need several yardsticks, masking tape, clothesline, and approximately 120 yards of twine or heavy string.

With the yardstick and tape, mark each yard along all walls starting with one corner of the room. Assign a numeral, letter, or symbol to each location and write it on the tape. Place the masking tape at eye level so everyone can see the markings from their desks. From these markers the children should try to imagine the grid that would criss-cross the room and then draw maps to show the layout of desks and other objects in the room.

If members of the class have difficulty imagining grid lines stretch clothesline, twine, or string between markers to graphically illustrate the grid.

Allow a great deal of freedom for the children to move around the room to verify the accuracy of maps.

GRID GAMES, like checkers or chess, can be introduced at any point during these activities.

New grid games can be invented by two players sitting opposite each other with a large barrier such as a notebook set on end between them. The first player establishes a grid size, the second player draws the grid or obtains graph paper.

Using colored toothpicks, buttons, or small blocks, the first player places one piece on the grid and tells the second player where he is putting his piece. He includes the name of item, color, and location on the grid. The point of this game is to create an interesting design that can be duplicated by the second player using oral directions. Language and communication skills are also developed during this game.

MAP DRAWING can also take place outdoors.

In the preceding mapping activities, the encompassing square was already laid out for the students on a desk top or in the room. Now the teams must figure out how to make their own <u>square</u> plot.

Give each team a 48 ft. twine, knotted at 12 foot intervals. Masoner's line works well as it does not stretch or tangle easily. Also, provide each team with four large spikes, mapping or graph paper, a cardboard cut the same size as the mapping paper, tape to attach paper to cardboard, a string which reaches across the mapping paper, tacks or nails, a quantity of tongue depressors, and yardsticks (or yard long pieces of twine marked in one foot sections).

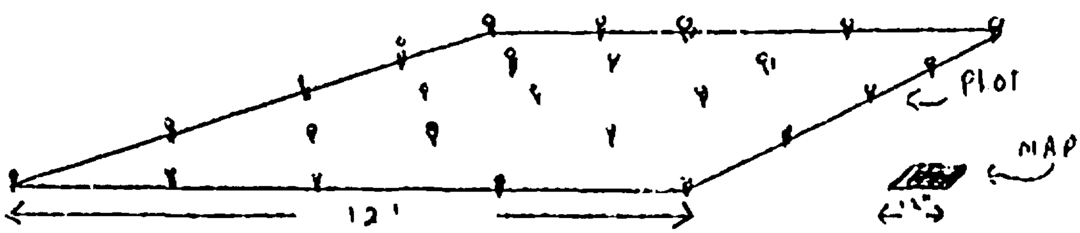
If you must make your own mapping paper, trim a large quantity of 12" x 18" drawing paper to 12" x 12" dimensions.

The game takes place on the school yard. Select an area of the lawn or playgrounds for each team's plot. Each team should make a square plot 12' x 12'. Do this the same way the vacant lot plot was set up. See page 1.

When the perimeter of the plot is marked, the children can grid it using nails or tongue depressors and twine.

A 3-foot grid is made by inserting nails or tongue depressors into the ground every three feet along the boundary of the plot. The result is a 12 foot square plot, divided into a 3 foot square grid.

Plan how to reproduce this 12' square on 12" square paper.



The scale is 1 inch = 1 foot

Push a piece of paper onto a nail in one corner to mark it as corner #1 for reference while mapping. If there are no trees, slides, or other objects on the 12' plot, several sizes of sheets of paper can be used as the objects to be shown on the map. Poke nails through the papers to prevent them from blowing away. Place the papers at random on the plot and at various angles, with some sheets crossing from one section into another.

Each team should sketch the papers in the correct grid section and to scale.

Remove each paper and replace it with an inconspicuous marker. Teams should switch plots and maps. Each team should attempt to replace the papers in the correct positions on the plot by using the map given them by the other team.

Try switching plots several times. Discuss reasons why some maps are hard to follow (incorrectly labeled, not drawn to scale, not gridded correctly, etc.).

Repeat the game using objects other than sheets of paper. This time make a key for the objects and record only the key symbol on the map. The children won't have to draw the objects to scale with this kind of map.

CONTOUR MAPPING

Background

The distribution of plants and animals in a given area may be more completely understood by examining the physical characteristics of that area. Elevation variations and angle of slope are both important determinants of vegetation cover. Striking differences in size and type of plants may be commonly observed, especially in an area relatively undisturbed by man.

Correlations between vegetation patterns and topology may be made after a slope is contoured. This is accomplished by establishing a transect on a slope. Plant samples are collected or observed along this line with particular attention directed to the type and size of plants occuring on it. The data collected is then organized into a vegetation profile which reveals change as it related to topology.

Once a transect is established, additional environmental factors for example, soil type, light intensity, and temperature may also be investigated. These data together with topological information combine to present a relatively complete picture of any study area.

This lesson suggests a reasonably simple procedure for developing a contour map The equipment is inexpensive and can be built by the children at home or in class. The major requirement involves locating a suitable hill for study. You may need to spend time identifying your study site before you begin the lesson.

After contour maps of your site are made, the class will establish a transect for a plant population study. The final activity will be to correlate the type and size of plants occuring on the transect with variations in the topology of the area. Maps will be constructed to aid in the interpretation of the vegetation pattern occuring at the study site.

You may wish to review some techniques of map preparation with the class prior to the introduction of "Contour Mapping." Environmental Science Center lessons "Introduction to Mapping" and "Mapping, Altitude, Representation, Contours," would provide the students with a basic knowledge of mapping procedures.

As you read through this lesson some portions may seem difficult to understand or the technique is not easily visualized. Therefore, it is strongly advised that you build a set of the equipment and practice its use before the lesson is introduced to the class. Your knowledge of both the equipment and procedures for its use will be of help to the children when they begin.

MATERIALS

Items	Description and Source	Quantity
6 oz. Juice Can	Home	1 per group of 3
Plumb line	Hardware store	1 per group
Grid paper, 1/4 squares	School	3 sheets per student
Masking tape	School	4 rolls
Colored tape, red	Hardware store	5 rolls
Hammer	Home, school	1 per group
Rope, 30 ft. length	Home	10 lengths
Nails	Home	1 per child
Teardrop sinkers	Hardware store	1 per group
Clear Pine Poles (1x2x4)	Lumber Yard	1 per group
Clear Pine Poles (1x1x8)	Lumber Yard	1 per group
Black Grease Pencils	School	1 dozen
Scrapwood 8 in lengths	Home	10 per group
Cup Hoods, small	Hardward Store	1 per student
Compass (optional)	Home, hobby shop	1 per pair

PROCEDURE

Part 1: Building the Equipment*

Gather together the materials needed and set aside several periods for assembling them. The children could build the equipment at home, but they may enjoy doing it together as a class project. Your supervision will help insure a certain degree of standardization among the various pieces built.

Basically the equipment consists of four pieces of apparatus: a sighting device,

*An alternative method is described in the Environmental Science Center lesson, "Stream Profiles."

range pole, stake, and marked rope for measuring. Each group of three children should make one of each. Below are directions for the construction of each piece.

A. SIGHTING DEVICE

MATERIALS

Orange Juice Can
1x2x4 Clear Pine Poles
Cup Hooks
Nail
Masking Tape
Sinker
Plumb line
Grease Pencil
Hammer

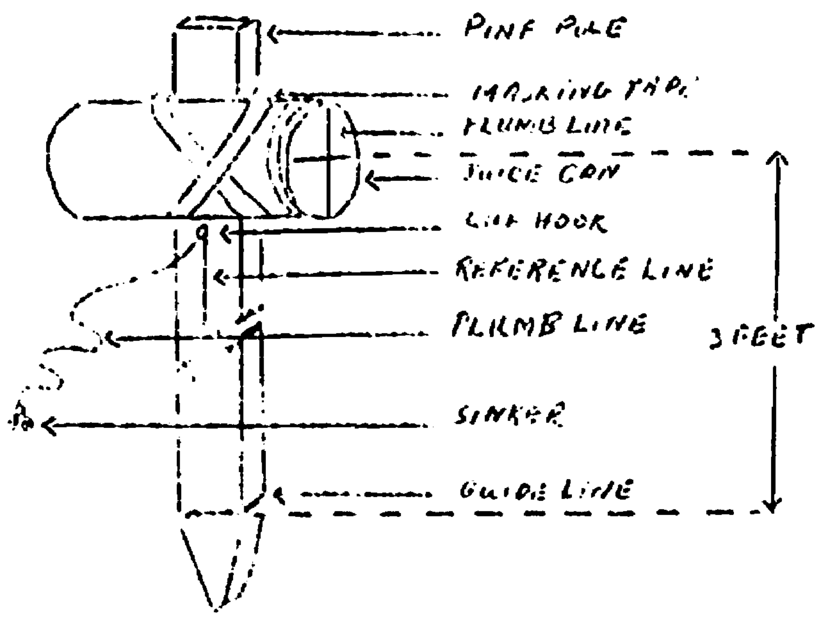


Figure 1, Sighting Device

Before attaching materials to the pole, one end of it should be shaped like a stake so that it may be driven into the ground up to the Guide Line. Perhaps this can be done at home before it is brought to class.

The orange juice cans are to be used for the improvised sighting device. A hole is punched in the middle or the end with a nail. Four small holes are punched around the edge of the other end so that two lengths of plumb line can be strung through the holes dividing the open end into four quarters (See fig. 1). Draw plumb lines through the holes and fasten them to the can with masking tape.

Use a nail to start a hole in the pine pole about 2 - 3/4 inches down from one end. Screw the small cup hook into that hole. Attach the sinker to the plumb line and tie it to the cup hook. A leveling device is thus formed. When the pole is upright the plumb should line up with a vertical line — the reference line— drawn on the pole with a grease pencil. The distance between the juice can center and the guide line at the base of the pole should be three feet.

Attach the orange juice can tightly above the cup hook by wrapping it to the pole with masking tape. The can should be positioned at exact right angles to the pole. This last step completes the sighting device.

B. RANGE POLE

MATERIALS

1x1x8 Clear Pine Pole
Red Tape
Black grease pencil
Yard stick

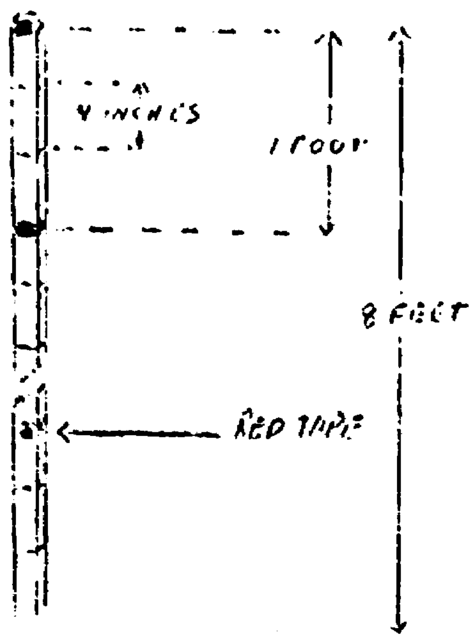


Figure 2, Range Pole

Measure one foot intervals on the pole and mark them with a pencil. Wrap red tape around each mark and make certain the ends have tape around them also.

Divide the interval between one foot lengths into thirds and mark these points with the grease pencil. (See fig. 2) If the hill chosen for study is over-grown with vegetation, it would be well to consider painting the range pole white for ease of spotting.

C. STAKE

MATERIALS

8 inch pieces of scrap wood
Red tape

Any piece of scrap wood will do, a 1x1 or 1x2 are preferable. One end of each can be shaped so that the stake may be easily pushed in the ground. The tops of each stake may be wrapped with tape so that they are easily seen in tall grass.

D. ROPE

MATERIALS

30 foot rope lengths
Red tape

Measure 3 foot intervals along the length of the rope and mark them with red tape.

Once the equipment is built, the students should spend time in practicing its use.

Part 2: Practice on the school grounds.

The class may practice using the quipment indoors, but more space would be available on the grounds of the school. During the course of building the equipment, students no doubt discovered how the juice can with its crossed threads could be used as a sighter. The technique of spotting something by viewing the crossed lines is the same as that used when the range pole is sighted through the can. It is important now to use the sighter in conjunction with the plumb line leveler attached to the sighting device. All sighting must be done only when the sighter is <u>plumb</u>.

Divide the class into groups of three students each. A group should have a sighting device, range pole, and rope. One student will handle a range pole, another the sighting device, while the third has the responsibility of seeing that the sighter is level. Position each group along a line somewhere in a grassy area of the school yard. Direct the individuals with range poles to place them several feet away from students with sighters. Have the sighter drive his pole into the ground up to the guide line so that it is firmly positioned. The third member of the group should determine when the plumb line drops straight toward the ground thus leveling the sighter. Once the sighter is level, the person doing the sighting should view the range pole through the juice can. The person on the range pole should move his hand down the pole until it intersects the sighter's line of vision as he views the pole. The range poler can check the distance from his hand to the ground by reference to the scale on the range pole. What is this distance? (See Fig. 3)

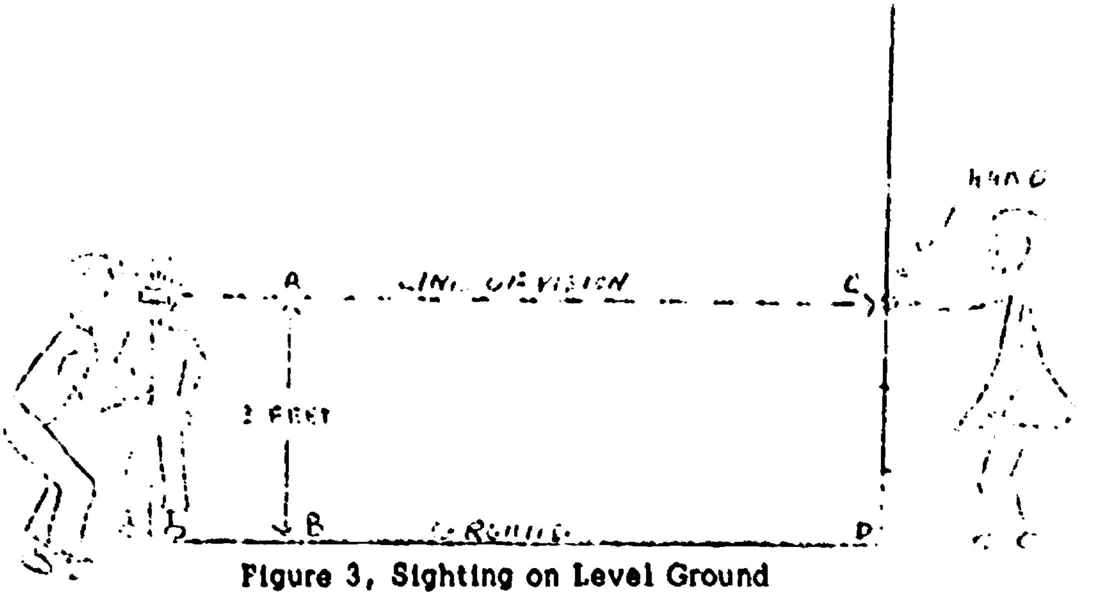


Figure 3, Sighting on Level Ground

The students should discover the relationship between their <u>line of vision</u> as it hits the range pole and the ground CD and the distance from the crossed threads on the juice can to the ground AB. In other words, if the sighting device and the range pole are at points of <u>equivalent elevation</u>, the distance from sighted point on the range pole to the ground should equal the distance from crossed threads on the sighter to the ground. It may not be easy for the students to see this relationship at first. Have the third student measure those two distances with his rope. These figures shoul be reported to the other members of the group. Have the groups continue practicing and sighting with each member in turn using the different pieces of equipment.

When each student has had an opportunity to familiarize himself with the equipment, move the group to an area of ground where a slight elevation exists. If none is to be found on your school grounds, stairs or other objects may be used to elevate the range pole. The class must see what occurs when the range pole is placed at a point <u>higher</u> than the sighting device. Perhaps it may only be necessary to life the pole off the ground to create an elevated situation. But this situation is not as desirable as would be one of real elevation. Whichever obtains, have each person with a range pole stand on an elevated point while the sighter fixes his eye on the pole. The poler should move his hand down the pole until it intersects with the sighter's line of vision. Have the poler read the distance from his hand to the base of the pole (CD). How does it compare with that measured when he was previously standing at ground level? What does the difference mean in terms of his height relative to that of the sighter? (See fig. 4)

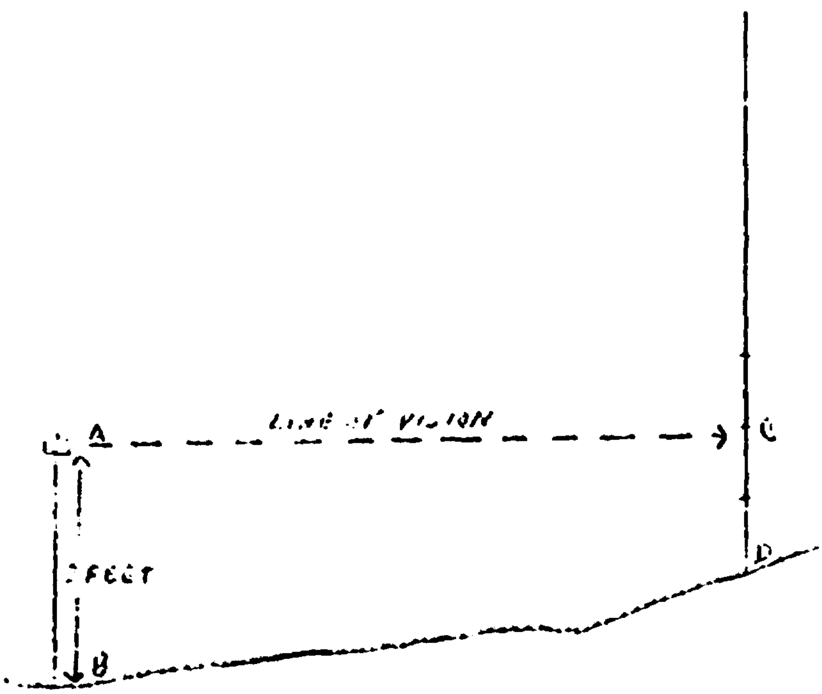


Figure 4

The students should begin to understand that distance AB and CD will be equa when the range pole is at the same elevation as the sighting device. However, if the pole is elevated the distance CD is not going to the same as AB. This is because point C is not fixed as are A, B and D. Distance AB never changes.

Once the students have had sufficient experience with the equipment to discover these ideas, it may be helpful to draw figure 4 on the board for them when they return to class. It will help them visualize the geometry involved in the activity.

Perhaps they have discovered for themselves that distance CD is always smaller than AB if the range pole is placed at a point of elevation above the sighting device. (Figure 4) Under what circumstances would CD be larger than AB? How could these circumstances be created? Students should be given the opportunity to work with the equipment to discover this new situation. It may arise in the field work they will do later.

An amount of time sufficient for acquiring an understanding of the above should be allowed before students begin their field work. How much time is needed will depend upon the age and ability of your students. Use your judgment as to when you feel they are ready to continue with the activities. It is worth mentioning that these activities require teams to work together cooperatively. Much time could be wasted in field work if the children do not work well together. Your job supervising the field work will be much simpler if you are able to obtain the full cooperation of each class member.

Part 3: Field Work

A. SLOPE IDENTIFICATION

Before the class begins to work on a slope, identify one near the school which has sufficient elevation for practice. Examine park areas within walking distance or any other hill you feel would be suitable. If it happens that the hill is on private property, check the trespassing regulations.

Some of the criteria to be kept in mind as you choose a hill are its accessibility, size, and angle of slope. Its size must be sufficient to accommodate a class so that teams are not in one anothers way. The slope should be steep enough to produce results but not difficult to ascend. Climb the slope yourself and use your judgment.

Many schools will not have a good hill within walking distance. In this event, the possibility of field trips should be explored in order to accomplish this part of the lesson.

The amount of time needed in the field will be directly related to the degree of organization established before the trip. It is strongly recommended that you study the hill, keeping in mind how you might position the teams on it. Make a sketch of it for the class and indicate where each team will work. Have equipment ready for the trip. Below is a list of what will be needed.

Item	Quantity
Sighting Device	1 per team (3 students)
Range Pole	1 per team
Stakes	10 per team
Rope Measurer	1 per team
Paper and Pencils	

B. MAPPING A BASELINE

The baseline will be the starting point for all teams. As its name implies, it is is established at the foot of the hill and is nothing more than a line upon which all established points are of equal elevation. It is the first contour line; all other lines developed are done so relative to the baseline. It is best that only one team be involved in staking the baseline. Therefore, while this is being done, the other students should practice sighting the range poles placed at points of varying elevation.

To develop a baseline, start at any point at the bottom of the hill; this point is determined arbitrarily. Drive a stake in the ground at the chosen point and position a sighting device at that point. Have a range poler place himself about 10 feet away from the sighter, but not up the hill as the baseline will run around the bottom contou of the hill. The sighter should sight at the range pole to see whether or not it is placed at a point of elevation equal to that of the sighter. If not, the poler should move the pole around until that point is found. (See Figure 5) The third member of the team should make certain the sighting device is level. When the sighter fixes his vision on the range pole and finds that they are both at equal elevation, a stake should be placed at the range pole's position. It would be helpful to recall to the students their work on level ground at school. They must keep the idea of equivalent distances in mind. (See Figure 4)

Once the second stake is in place, the sighter moves to it while the range pole is moved away another 10 or so feet. This distance can be measured with the rope. Another isghting is made to determine a third point at which elevation is equal to that of the first two. Continue to have the students sight and stake these points until the number of stakes placed equals the number of teams in the class. Each team will beg its work up the hill from one of the stakes. The baseline staking team may then examine their work to the rest of the class.

Next, each team must determine the distance between zero line and his stake. (See Figure 5)

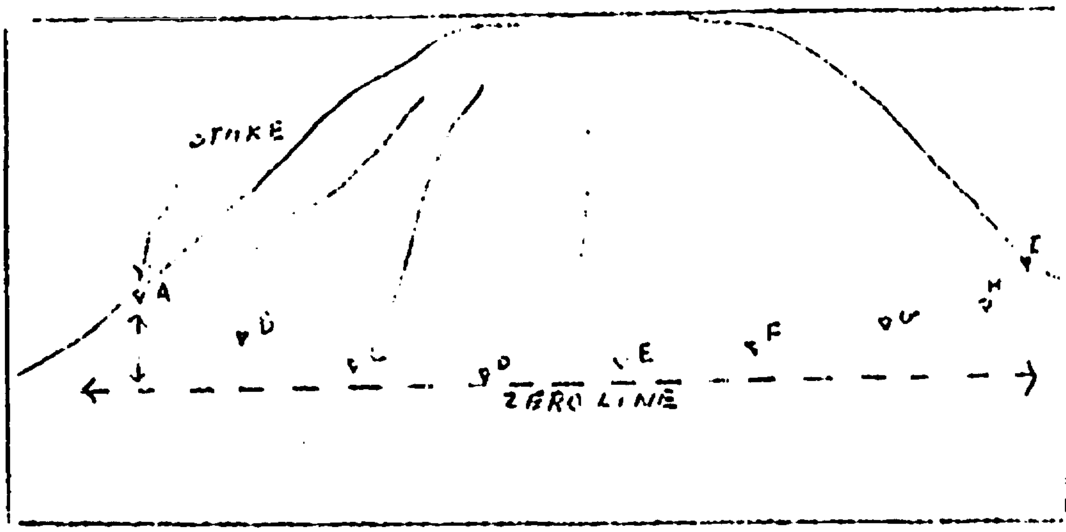


Figure 5, The Baseline Staked Around the Hill with the Zero Line Shown

Note each stake is identified with a letter. Each team should be identified with a letter so that their relative positions are known. Stake D is seen to be furthest down the hill. (Actually, stake D may be no further from the hill top in linear distance than any of the other stakes, but for purposes of description it shall be termed furthest.) If a straight line is sighted, "horizontally" through D as shown, the othe stakes are seen to be varying distances from the line (zero line). Those distances should be measured and recorded from each stake. D stake is 0; each other stake is 0 plus whatever distance it is from the line. When the data are collected and graphed, each group will place their data on a graph beginning at a point which correspond to their linear distance from 0. The 0 line can be easily determined by using a compass, or it can be sighted by the eye. While a compass would be a valuable addition to the technique in this lesson, it is not a necessity. If some of your studen are familiar with its use, they may be willing to teach others how a straight line is determined with one.

C. Contour Mapping

When the teams are positioned on the baseline, each sighter should face the slope and look up the hill. His line of vision should rest on a point perhaps halfway up. This line of vision should be parallel to that of each team so that each works up the hill in a stright line. If teams deviate from these lines they will find that their paths might cross somewhere on the hill. In order to avoid this, each team should place a sighting stake somewhere up the hill to help guide them as they work. You can check these stakes with the help of the students to see that their lines of work will be parallel. Again a compass could be used to position guide stakes; however careful measuring and sighting will result in straight lines. The distance between these guide stakes (Q) should be equal to the distance (R) between the stakes on the baseline. (See Figure 6.)

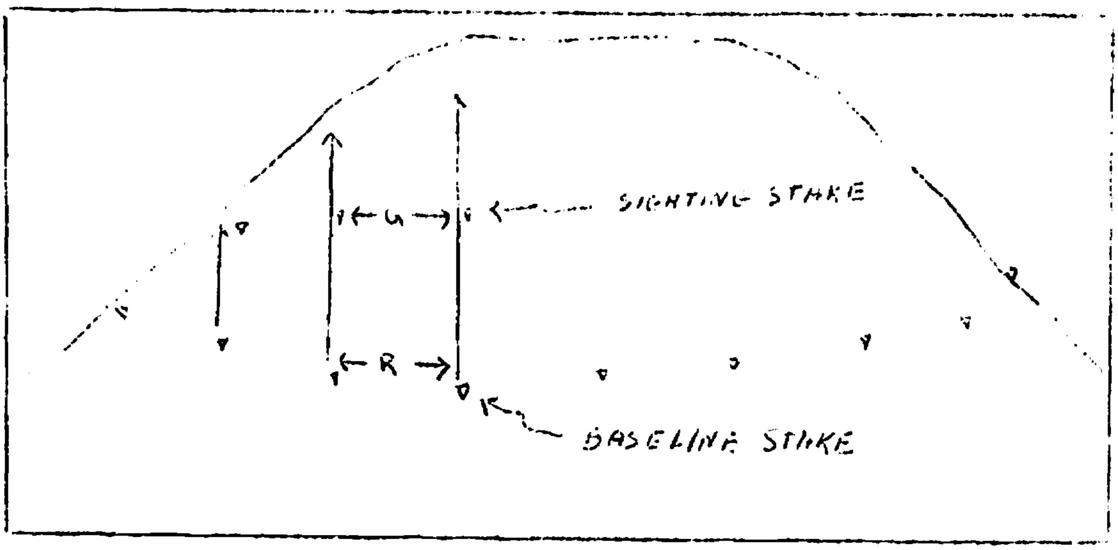


Figure 6. Establishing a Straight Line up the Hill.

Once this is done, the students are ready to begin the process of surveying the hill. Heretofore, students have been sighting on a fixed point (establishing the baseline) or at some non-fixed point below it. (See Figure 4)

You must now determine a fixed contour interval by choosing a point on the range pole upon which all sightings are made. You could choose the bottom mark on the pole but if the ground is over-grown with fairly tall grass, all sightings should be made at least one foot above the ground. (See Figure 7.)

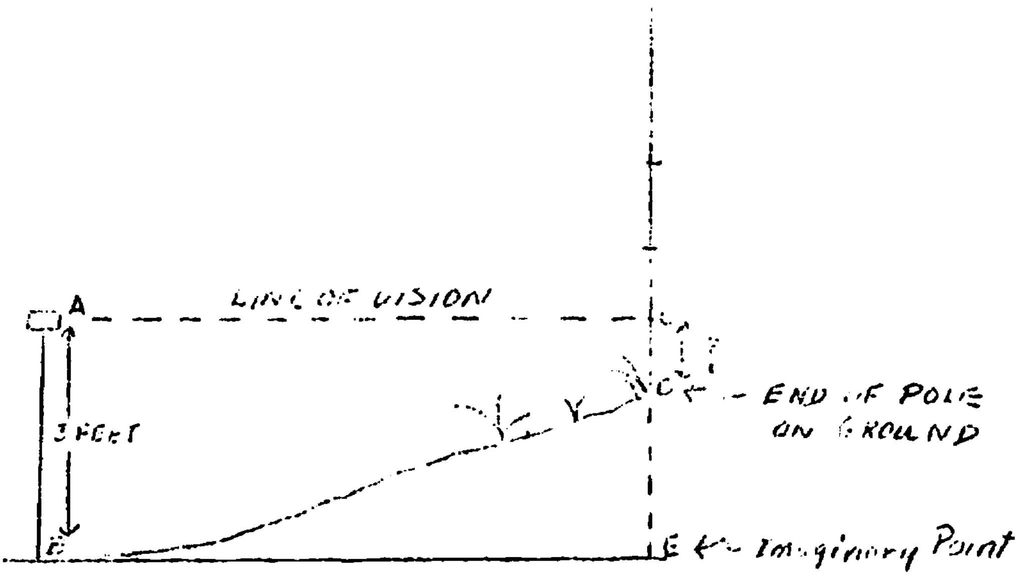


Figure 7. Determining the Contour Interval

In Fig. 6, the sighter is shown sighting a point (C) one foot above ground level. What is the difference in elevation between the poler and the sighter? If the line of vision begins three feet from the ground at point (A), what is distance CD. It is actually distance AB minus distance CD or two feet. Another way to express this is to say that point (D) is two feet above point (B). Now, think of distance DE--although it cannot be demonstrated. This will be their contour interval.* A two foot contour interval will probably be adequate for their work. If teams sighted the bottom of the pole, what would be the size of the contour interval?

Once a convenient interval is chosen, it could be indicated on the range pole with tape of another color. Thus, if the one foot level is chosen as discussed above, it could be made more visible by wrapping black tape around the upper and lower margins of the red tape. Convenience is determined by size of the children, steepness of the slope and time--a larger interval means fewer sightings and less time.

To begin the surveying, each team sighter places his device at his team's designated baseline stake and directs his range poler to move up the hill slowly in a straight line until the sighter views the point on the pole he wishes to sight. The third member of the group should see that the sighting device is plumb. When the poler is at the proper elevation, a stake should be driven in the ground at that point. It may be referred to as stake number one and should be lined up with the stake on the baseline and the guideline stake previously placed up the hill. Now the distance between stakes one and two should be measured and recorded. The third member of the team may take the responsibility of doing the recording. Measurements are made with the rope. (See Figure 8.)

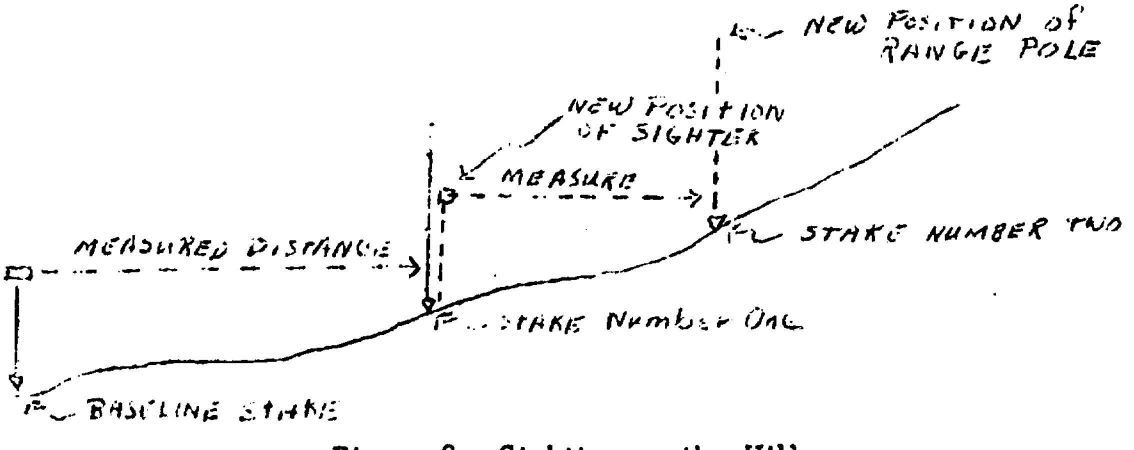


Figure 8. Sighting up the Hill

After each group has completed this procedure, the sighter will move up the hill to the newly placed stake and repeat the foregoing. The remainder of the work is merely a repetition of sighting, staking, measuring and recording until the top of the hill is reached. Measurements can be recorded according to stake numbers. Thus stake number one is recorded as X feet. This means it is X linear feet from the baseline stake. Others can be recorded similarly with stake 2 X feet from stake 1. (See Figure 8.)

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* The contour interval is the difference in elevation between each successive point sighted as the class moves up the hill. This difference will always be the same once the size of the interval is determine.

While it is not necessary to use stakes, they are an aid in determining whether a team is moving in a straight line. In the event teams do not have a sufficient number of stakes or should they run out of them, the poler stays in position until the sighter moves the equipment to that point.

At some time, perhaps after the third stake has been placed, direct the teams to observe their position relative to one another. Are all the teams at the same point of elevation? Some of the teams will reach the top before others. These groups may wish to check stake lines, review their data or discuss some of the problems which developed as they worked up the hill.

If the hill was wooded and their line would have gone through a tree, how did they deal with this situation? Did anyone go through a gully area to find the range pole lower than the sighting device?

C. Mapping Down the Hill

When the entire class has reached the top, inquire if they can accomplish the same thing if they were to go back down the hill. In other words, may contours be determined starting at the top and working down the slope? If so, how could it be done?

As the class proceeded up the hill, the measured distance between the sighter and the stake was found to vary with the angle of the slope. That distance was determined by the contour interval. The situation is somewhat different as one proceeds down the hill. Another fixed sighting must be used in this instance. This means that the sighter must select a mark higher on the range pole and "shoot" at that mark only as the team descends the hill. (See Figure 9.) The mark chosen is determined by the size of the contour interval. If it was two feet going up the hill, it will be two feet going down. This time the sighter's point will be above the point he would ordinarily sight if both range pole and sighting device were level with one another. (See Figure 3.)

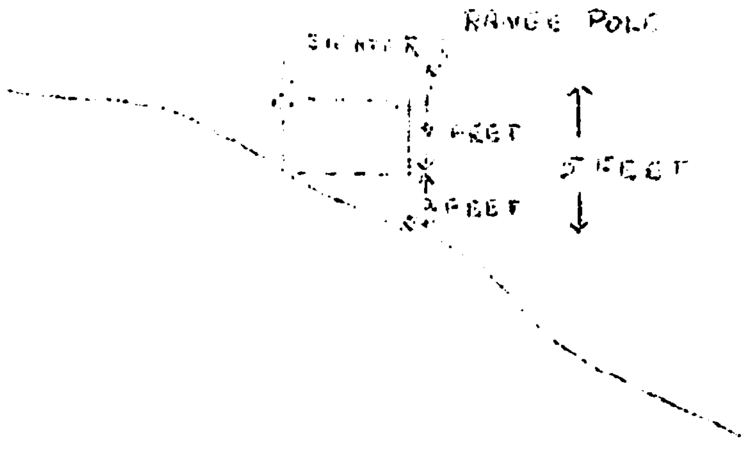

Figure 9. Sighting Down Hill

In Figure 9, a two foot contour interval is maintained by sighting at the five foot mark. If the class had used a three foot contour interval, what mark would they sight on the range pole? Again it would be helpful if the fixed sighting point on the range pole was clearly marked. Black friction tape could be wrapped around the pole at the chosen point to delineate it from the other marks. If time permits, the class may now work their way down the hill sighting, staking and recording elevation and distance between stakes.

D. Recording Data

Below is a simple chart indicating how records might be organized. These data will be used when contour maps of the area are made following the completion of the activity. Each team should keep similar records.

Baseline Elevation	Contour Interval	Stake Number	Elevation	Distance
0	3 ft.	1	0	2 ft.
0	3 ft.	2	2 ft.	10 ft.
0	3 ft.	3	2 ft.	3 ft.
0	3 ft.	4	2 ft.	6 ft.
0	3 ft.	5	2 ft.	7 ft.
0	3 ft.	6	2 ft.	4-1/2 ft.

Note: The contour interval remains constant. This is because the length of the sighting device is fixed as is the point sighted on the range pole. The relationship between the contour interval and elevation and distance is seen more clearly in Figure 8.

Part 3: Organizing the Data.

The data should be organized either back in the classroom or in an enclosed area on a large flat surface. Each group should tape two pieces of graph paper together end to end on a sheet of butcher paper large enough to accommodate graphs from each group placed side by side. A scale marked off in equal intervals should appear at the left hand margin of each graph. Each sheet of graph paper should bear the letter assigned to each group. Group A will place their data on the first set of graph paper to the left of the others. Group B will take the next position to the right of A and so on. After the graphs have been identified with team letters and scales are drawn, a review of their work should be conducted. Discussion will help them to focus upon the more important aspects of the activity. Following are some questions which you might pose to the class for consideration·

1. What was the elevation of the first stake relative to the baseline?

2. What was the elevation of the second relative to the first?

3. Was the distance between stakes always the same?

4. If not, why were there differences?

5. Of what importance is the baseline?

6. Did everyone obtain the same data? Why not?

7. What might have happened if the sighting devices had not been of equal lengths?

8. Could sighting devices be either longer or shorter than those used? How would a shorter device change the data? A longer one?

9. Might similar results be obtained if each group surveyed around the hill instead of up it?

When sufficient discussion has taken place, groups may be asked to place their data on the graphs. The data should be entered carefully in the following way: (See Figure 10.)

1. The team whose starting point was termed zero should place an X on the horizontal axis of their graph at the zero point. This X should be on the midpoint of that axis.

2. Other groups, starting at zero, should count up the required number of feet on the scale and place an X on their graph representing the distance between zero and their baseline stake. These stakes may also be labeled zero. (See Figure 5.)

3. The position of each successive stake should be so marked on the graph and a number placed next to each X so that stakes are seen to follow one another in order. (See Figure 9.)

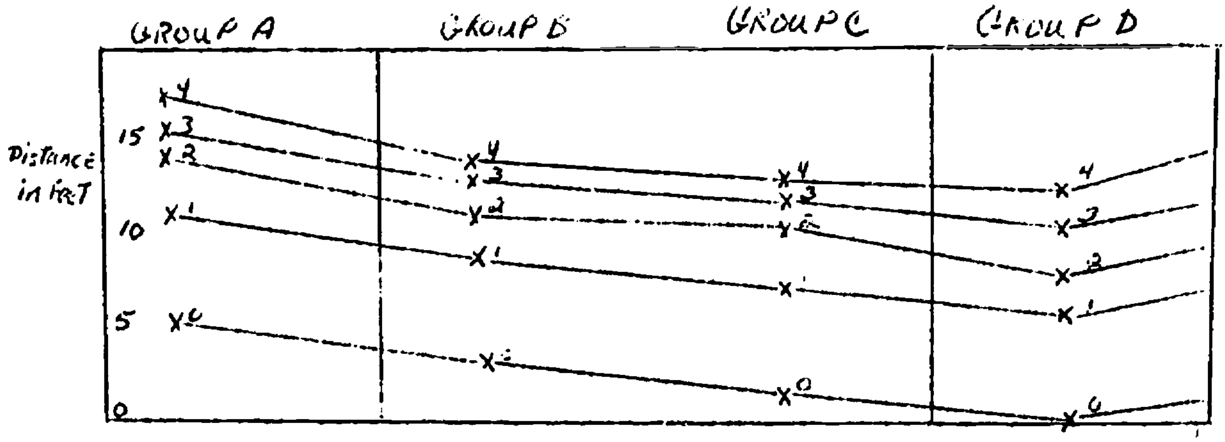

Figure 10. Charting the Data

The distance between successive X's represents the measured linear feet between stakes. Once all the data have been charted, the X's should be connected with lines. Each X marked 1 should be connected to all other ones; two to all twos and so on; The resulting lines are termed contour lines; the graph, a contour map.

The children should spend some time now examining both the map and the hill. How are the steeper parts of the hill revealed on the map? The more gradually sloping parts? How do cuts or gullies appear? How would changing the contour interval change the contour lines? These and other questions may be discussed as the class studies the map.

Part 4: Additional Activities

A. Vegetation Sampling

Vegetation sampling was mentioned in the background section as one possible activity to correlate with contour mapping. If time permits, the class could collect single samples of the vegetation appearing near each stake placed as they work up a hill. These samples may then be placed on or taped to the contour map to indicate how the plant life changes with elevation. Changes are particularly striking if there is a marsh or pond near the bottom of the hill. Children could correlate available moisture with elevation.

B. Temperature

Temperature of both ground and air may be taken again at each stake point. This is apt to change as students progress up the hill.

C. Water Holding Capacity of Soil

The technique for determining the water holding capacity of soils is explained in an environmental science center lesson - "Water Holding Capacity of Soils". It can be applied along the stake line and results plotted on the contour map.

D. Soil Acidity

Other Environmental Science Center lessons deal with the relative acidity-alkalinity of soils. That procedure may also be employed here.

E. Soil Types

Soil types may vary with elevation. Types may be determined in a relative way by obtaining samples, examining them and comparing them to standard soil type descriptions.

A variety of other tests can be made up the stake line. Relative solar radiation, soil particle size, organic content of soil, insect and small mammal populations all may be investigated. The data resulting from such investigations can be plotted on the contour map. Eventually, a rather complete description of the area will emerge. The interrelationship between factors can be discussed; possible explanations for certain observations may be advanced by class members. Additional data may be collected to verify explanations.

Whether or not you choose to follow the contouring exercise with additional investigations will depend on the time you wish to spend on these activities. You may want to relate contouring to material in your geography classes or draw upon the mathematics employed here for your mathematics activities. As the students raise questions you will see possible ways of integrating this activity with other areas of the curriculum.