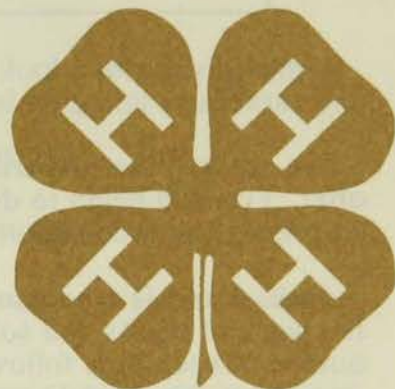


Exploring the World of Plants & Soils

MN 2000
FHMISC - 1977

UNIT II B
MEMBERS
MANUAL

SOILS



UNIVERSITY OF MINNESOTA
DOCUMENTS

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This manual centers on the wonderful world of soils. It leads boys and girls on into the science of plants, soils and other adventures.

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4-H PLANT AND SOIL SCIENCE PROGRAM

UNIT I

(Pick your choices)

- IA Plant Reproduction
- IB Soils
- IC Plant Growth Factors
- ID Plant Characteristics
- IE Growing and Using Plants

UNIT II

(Select one or more of the 5 areas) — 5 Manuals

- IIA Plant Reproduction
- IIB Soils
- IIC Plant Growth Factors
- IID Plant Characteristics
- IIE Growing and Using Plants

Unit I gives you a look at Plant and Soil Science. Unit II gives you more. They offer urban and rural boys and girls interesting things to do. They may lead to an exciting career.

We are told that experience is our best teacher. Exciting experiences are what the exercises offer. You will begin to discover what interests you; and that's important. You will have fun, surprises, and recognition for a job well done.

Units I and II lead you to more advanced studies in many areas. (See your leader.) Usually the work of plants and soils is grouped: Field Crops, Forestry, Horticulture and Soils. A brief outline of each area follows:

Field crops: corn, wheat, soybeans, field beans, sugar beets, flax, tobacco, rice, turf, forages, range, and other crops.*

Forestry: How forests serve us, and how to identify, grow, protect and market trees.

Horticulture: fruits, vegetables, gardens, flowers, ornamental plants, lawns, landscaping and floral arrangements.

Soils: classifying, mapping, improving, protecting and managing soils.*

There are interesting relationships with other sciences; for example, Entomology and Pathology.

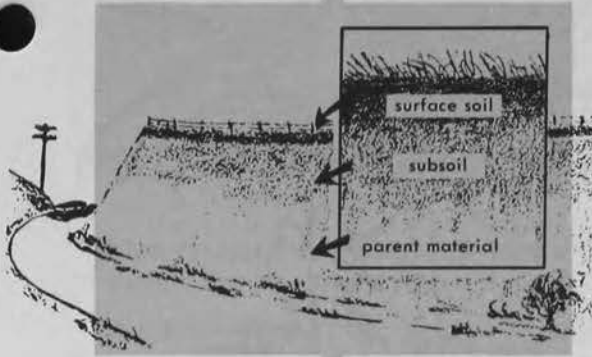
*Units III and IV will be available in these two areas.

Acknowledgment

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Special acknowledgment is given to the North Carolina State University Extension Service and to the editor, Dr. Emerson Collins, professor emeritus, who brought together ideas that are now in use in one or more states. These ideas are offered for use by all states. Appreciation is expressed to Amchem Products, Inc., for financial support in helping to make possible publication of this educational material.

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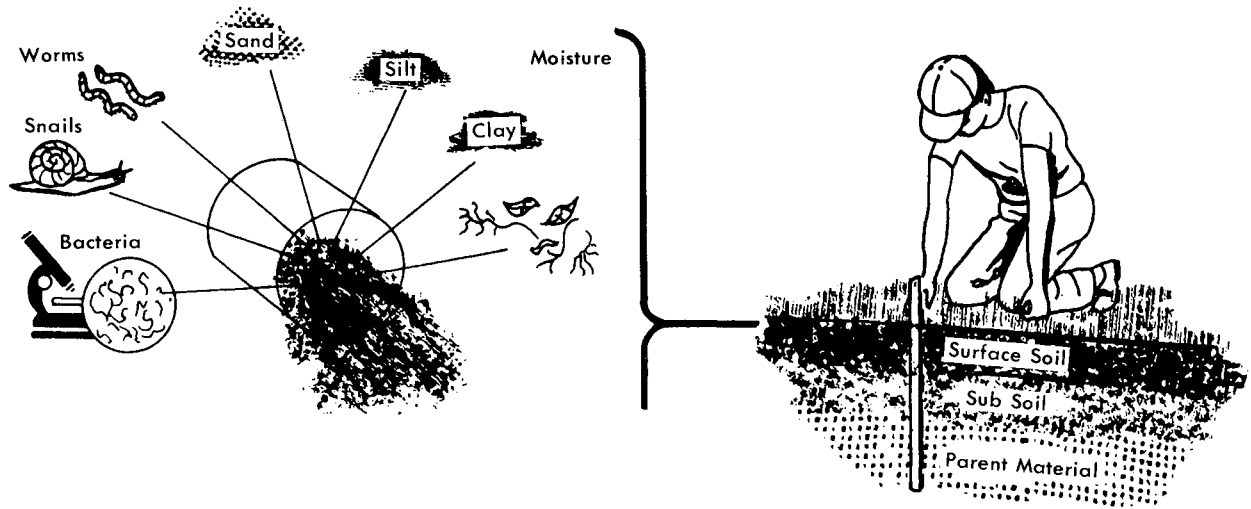
The World of Soils

What You Will Do

Look at the exercises in this manual.

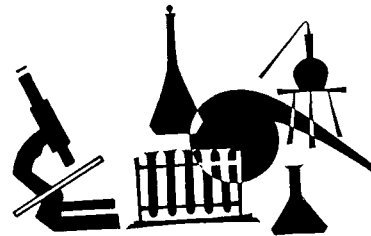
- Check the areas you would like to learn more about.
- Carry out four or more exercises that interest you. See your leader for requirements to complete a project. You can do exercises alone, with a partner or group.
- Turn to page 21 for a definition of some unusual terms used in the exercises.
- Make notes in the margins of pages of this book to help you remember just what you did and what happened.
- Attend meetings when the projects are demonstrated.
- Take part in tours and field trips selected to interest your group.
- Get more information on the subject of greatest interest to you.
- Bring all your records together and review what you have done, for your final report.
- Turn in your completed project record to your leader by the requested date.
- Explain what you have learned in a report to your group and through your newspaper, TV or radio editor.

IIB. Soils

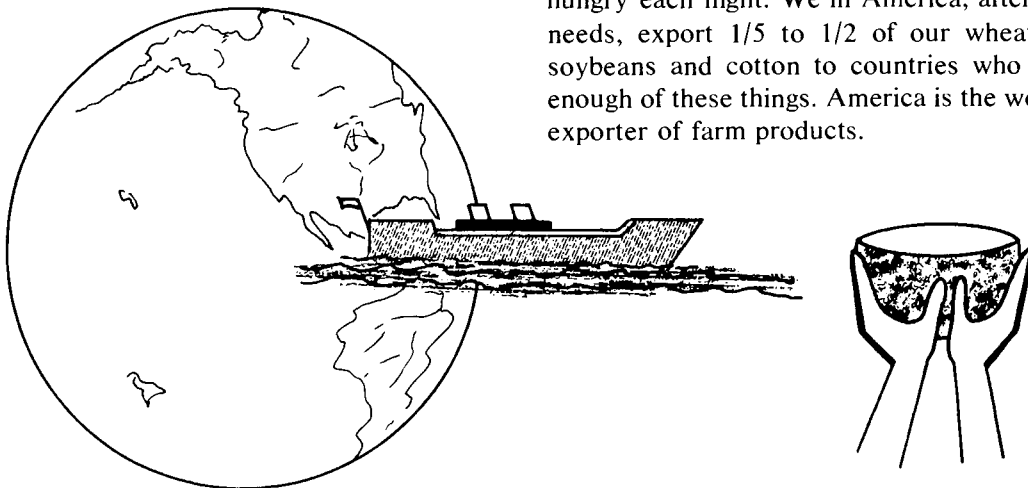


Have you ever thought of soil as a living, breathing thing? Really it is a storehouse of decaying vegetation, moisture and plant nutrients. Also it is the dwelling place of insects, microorganisms and higher plants. The soil teems with life. Persons, trained in soils, find many opportunities for work.

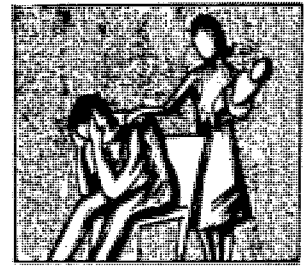
Included are field and laboratory investigation, soil testing, selection of construction sites, sales and distribution of agricultural goods and products, consulting and crop production.



More than half the people in the world go to bed hungry each night. We in America, after meeting our needs, export 1/5 to 1/2 of our wheat, rice, corn, soybeans and cotton to countries who do not have enough of these things. America is the world's leading exporter of farm products.



We must continue to study, conserve, and improve our soils. We must continue to produce enough to feed our people and share with others. Also, we should make the best use of our resources.



When man destroys vegetation, wind and water may join forces to destroy the soil. If this continues it leads to hunger, despair and starvation.

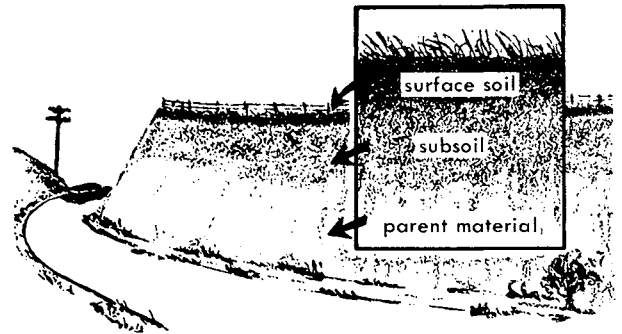
Man has learned that he must understand soil if he is to live well in his environment. That is the real reason why understanding the soil and its care is so important to all of us.

The following exercise will help you learn more about soils and their relation to plants and to people.

What Is Soil?

If you did not do exercise IB-1 in Unit I, it would help you to do it now. (reproduced below)

1. Look at the banks of road cuts, excavations, and other places where soil depth is exposed.
2. Keep a record of your observations. Include: location; depth of the surface soil* to a definite change in appearances (2" to 8"); depth of the subsoil* from the top soil to the parent material; color of surface soil, subsoil and parent material.
3. Take and label separate samples of the surface soil, subsoil and parent material at a few locations. These soils can be dried and placed in small bottles for display.
4. Summarize and write down your findings. Tell what differences you observed among the surface soil, subsoil and parent material. Include any other observations such as differences observed at different locations.



The following explanation is offered as a footnote to Exercises 6, 7 and 8. Also, page 3 "What is Soil."

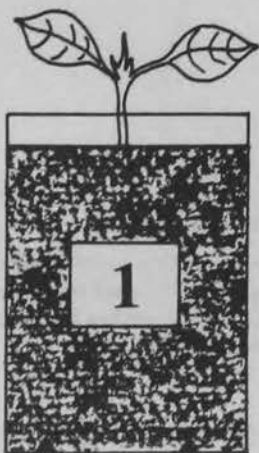
*"Surface soil" is the upper 2 to 6 inches of the land surface. For these exercises, subsoil is defined as the first layer of soil, beneath the surface soil, that is different in color and texture from the surface soil. If there is no noticeable difference between the surface soil and the underlying soil, then the subsoil should be considered that layer of soil that is 12 to 30 inches beneath the surface. Contact your County Extension Agent for more specific information on your local conditions.

- Soil texture is the relative amounts of sand, silt and clay in the soil.
- (1) Sand grains can be seen with the naked eye and are coarse feeling.
- (2) Silt particles can not be seen with the naked eye, and when rubbed between the fingers are smooth feeling like flour or powder.
- (3) Clay particles are the smallest (they are sticky and slick when wet). They can be rolled into a ball or rod shape.

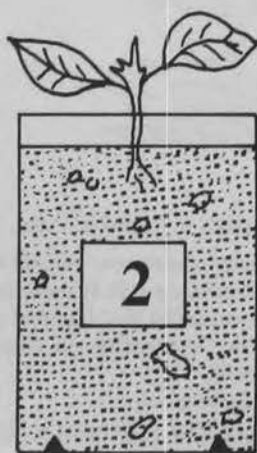
Here we will see the differences in four kinds of soil: sand, surface soil*, subsoil* and a garden soil. The garden soil should be typical of one that has had good treatment with fertilizer added.

1. Get four 5 quart oil cans or other suitable containers of equal size. The bottom 8 inches of a cut-off gallon milk carton is satisfactory as a container.
2. Punch several holes in the bottom with a large nail to allow drainage.
3. Label #1, #2, #3 and #4.
4. Fill #1 with surface soil from a field or garden.
5. Fill #2 with subsoil from the same area. (taken from a depth below an observable change such as color, texture or structure.)
6. Fill #3 with sand.
7. Fill #4 with a soil from the garden or a well fertilized area.
8. Be sure the soil in each container has been crumbled and broken up into small particles. Remove stones and trash.
9. Plant six peas, beans, corn or other seeds 1½ inches deep in each container. Set containers in warm, well-lighted place.
10. Keep moist and covered with a wet paper towel until the seed sprouts (germinates).
11. Observe and write down your explanation of any differences you see in the number of seeds germinating, also on the rate of plant growth and appearance.
12. Keep soil moist. Record the height of the plants in each container once a week for at least 6 weeks.
13. Write in your own words what you have learned by doing these exercises. How does this apply to understanding soils and plant growth.

*See explanation of surface soil and subsoil at bottom of page 3.



SURFACE SOIL



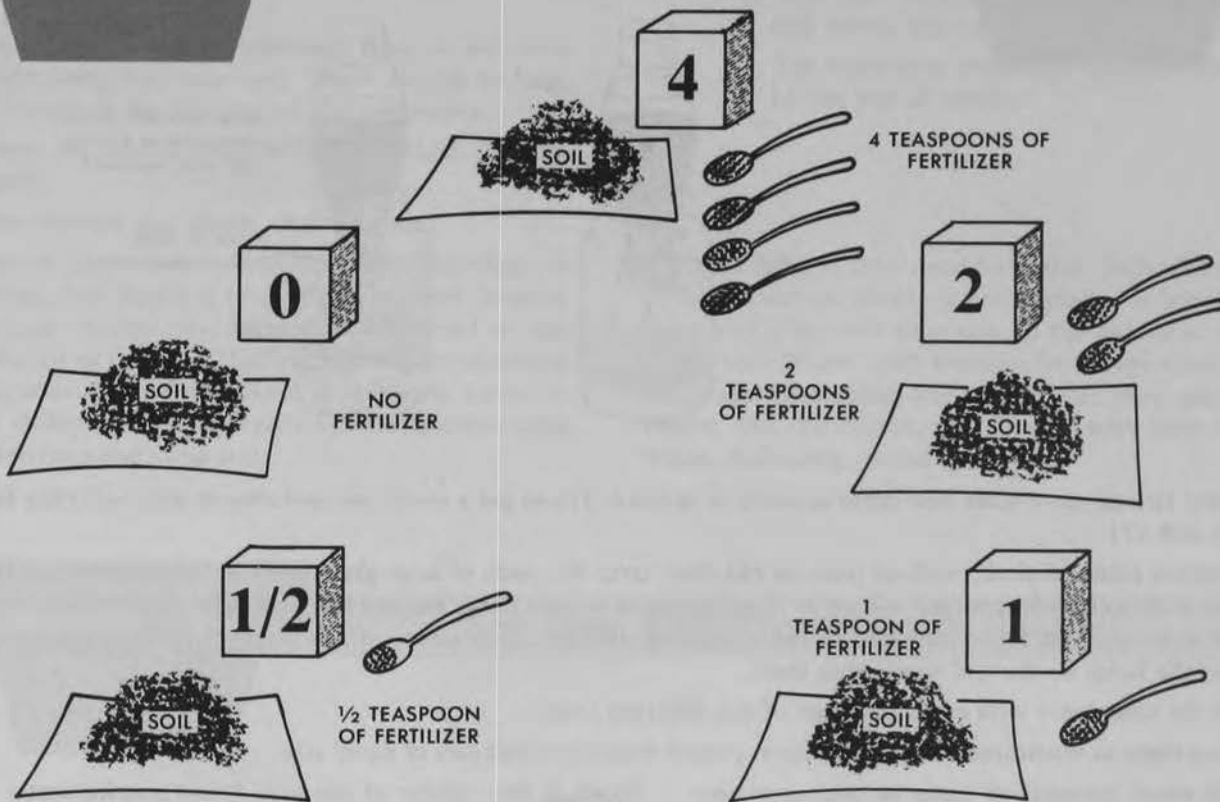
SUBSOIL



SAND



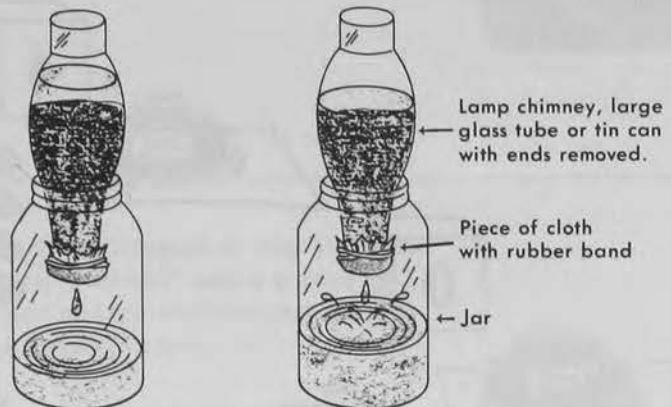
GARDEN



1. Select five suitable pots, tin cans or cut-off milk cartons that will hold 1 pint of soil. Punch holes in the bottoms for drainage.
2. Label "none", $\frac{1}{2}$, 1, 2 and 4.
3. Select a sandy, light-colored, low fertility soil, or fine sand from a builder's supply company.
4. Screen the soil to remove lumps, rocks and foreign material.
5. Place a pint of soil in each of the five numbered containers.
6. Get a small amount of fertilizer (8 teaspoons). This fertilizer should have three numbers such as 5-10-10, 5-20-20, 10-10-10, etc. Do not use 0-10-20 or a fertilizer with zero as one of the numbers. (a 5-10-10 means a fertilizer with 5% nitrogen (N) – 10% phosphoric acid (P_2O_5) and 10% potash (K_2O). Some states use N, P, & K instead of N, P_2O_5 , & K_2O).
7. Select the container marked $\frac{1}{2}$. Dump the soil out on a large piece of paper. Add $\frac{1}{2}$ teaspoon of fertilizer and mix thoroughly. Replace in container marked $\frac{1}{2}$.
8. Repeat step 7 adding the specific amount of fertilizer indicated by the number on the container for each. Do not add any fertilizer to the container marked "none."
9. Plant five seeds such as corn or beans one and one-half inches deep in the soil.
10. Moisten the soils until water just starts to run out of the holes in the bottom.
11. Water as needed and keep the containers in a warm, well-lighted place.
12. Record the height of the plants from the rim of the container at least every week. Also, write down your observations on the color and general appearance of the plants.
13. Did fertilizer increase the size of the plants? _____ Did you observe any unfavorable effect of the fertilizer, such as seeds which failed to germinate? _____
14. Explain in your own words how fertilizer helps grow plants. Also, list any precautions that you think should be taken in using fertilizer.

Exercise IIB-3

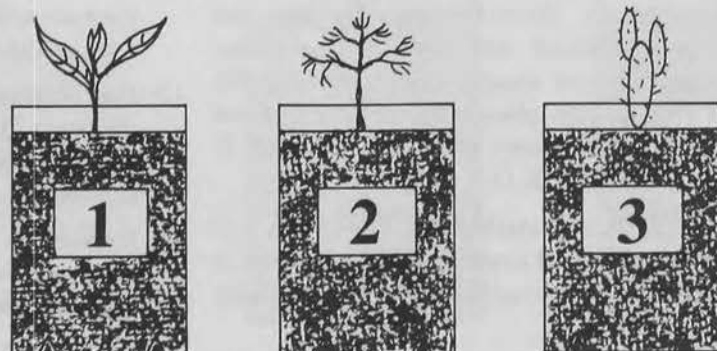
Capacity of Soil to Hold Water



1. Select two or more soils that differ in color or texture. Try to get a sandy soil and clay or silty soil. (See Exercise IIB-17)
2. Fasten a piece of cloth, such as from an old shirt, over the ends of large glass tubes or lamp chimneys. Drink cans with both ends removed will serve. Use a string or rubber band. Be sure it is held tight. Drink cans with one end removed and holes punched in the remaining end are satisfactory. Fit a piece of cloth or paper towel over the holes so the soil won't plug them.
3. Fill the containers with equal amounts of the different soils.
4. Place them as illustrated over mayonnaise, peanut butter or other jars of equal size.
5. Add equal amounts of water to each container — about $\frac{1}{2}$ the volume of the soil. Avoid pouring water into the jar below.
6. Note the rate that water is added and the time when water stops coming out of the bottom of the tube. This time interval indicates the rate that water moved through the soil (permeability, or filtration rate).
7. Determine the amount of water held by each soil and compare.
8. Write down your explanation for any difference noted in the amount of water held by the two soils.
9. Explain in your record how you might change a soil's ability to hold water. Also describe how to change the rate that water moves through a soil.

Exercise IIB-4

How Much Water Can Plants Take From the Soil?



1. Select two or more kinds of plants. Include a broad leaf plant such as the bean, or a small shrub or tree. Also, include a plant with leaves like evergreens (pine, hemlock or spruce) and a "succulent" (cactus or other desert plant).
2. Plant them in gallon containers filled to the same height using the same soil. There should be large nail holes in the bottoms of the containers.
3. Water as needed until well established (2 to 4 weeks).
4. Stop watering the plants. (Record date)
5. Record your observations each day for signs of wilting, leaf shedding or death of the plant. Explain in your record any differences observed in the behavior of the plant. Differences observed are the characteristics of the plants to conserve water, or the ability of the plants root system to extract the water from the same soil.

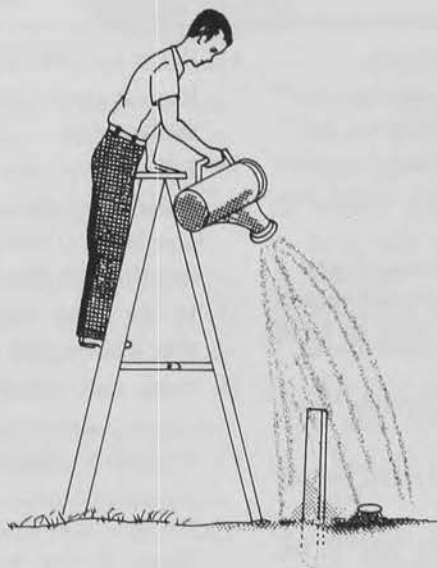
There are three kinds of water in soil:

1. The water held so tightly by the soil particles that plants can't use it.
2. The water held loosely by soil particles so that plants can use it readily.
3. The water free in the soil that runs through by the pull of gravity.

Plants differ in their need for water. Soils also differ in their ability to supply water to plants. A broad leaf plant and grass will soon use up the available water in the soil. Plants with needles for leaves evaporate less water than broad leaf plants. The third group of plants, like the cactus, can survive with little or no water, depending on the species.

Exercise IIB-5

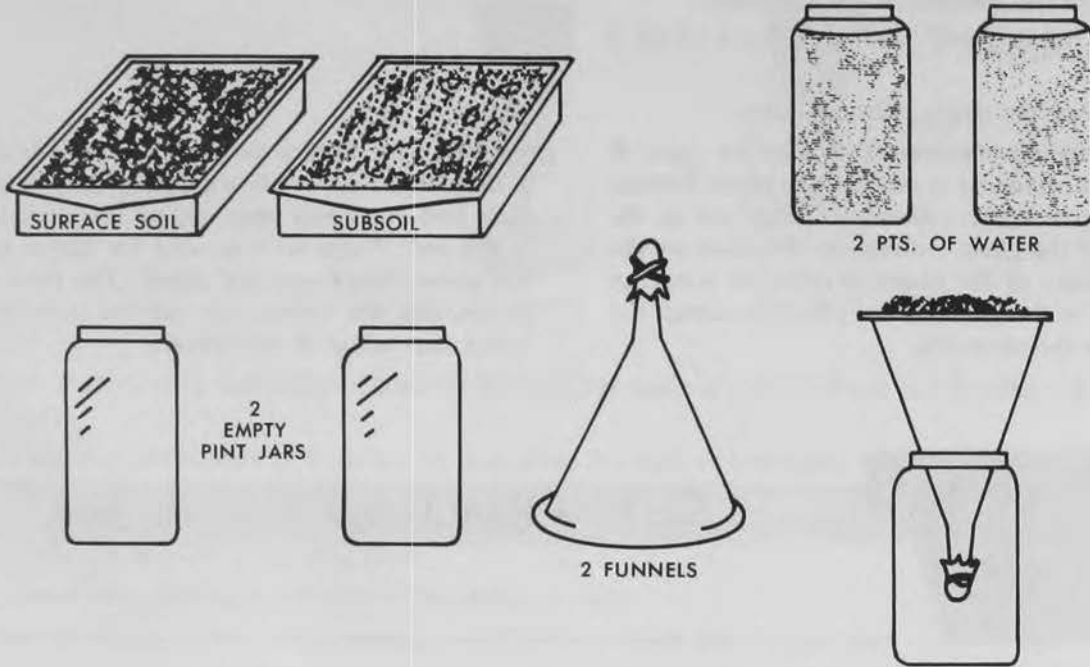
See How Rain Drops Wash the Soil



1. Drive a white stake 3 inches wide into bare soil (no vegetation) deep enough to stand. Lay a 50 cent piece near the stake.
2. Drive a second white stake in a good sod or lawn.
3. Fill a sprinkler can with water or use a hose with a nozzle set to sprinkle.
4. Place a box or step ladder near one of the stakes.
5. Stand on the box or step ladder and sprinkle around the first stake. Let the water fall from the can or hose to the ground.
6. Repeat steps 4 and 5 at the other stake.
7. Observe splashing of soil on the white stakes. List any effect of the 50 cent piece on the washing of the soil. Write down your explanation for any differences between the sod and the bare soil.

Exercise IIB-6

Ability of Surface Soil and Subsoil to Hold Water



1. Select a soil from a pasture or fence row.
 2. Collect a quart of soil from the surface soil* (relatively coarse layer). Label this "Surface Soil". Collect a quart of subsoil* (the finer textured layer, usually 12 to 24 inches deep). Label this "subsoil."
- NOTE: If you are going to do Exercise 7 and 8 also, you should get three quarts of surface soil and three quarts of "subsoil." Be sure to label them.
4. Get two flat, heat resistant pans. Label one "surface soil" and the other, "subsoil."
 5. Spread surface soil and subsoil thinly and evenly in the pans as labeled.
 6. Place both pans of soil in an oven at 200° F. for 24 hours or place them in the sun for several days.
 7. Stir soil occasionally, to ensure thorough drying.
 8. Place small pieces of cheese cloth over the spout of two funnels. Hold the cheese cloth in place with rubber bands.
 9. Place the funnels in empty pint jars.
 10. Gently fill one funnel with surface soil to ½ inch from the top. Do not crush the soil.

11. Place the pan of surface soil behind this jar.
12. Repeat steps 10 and 11 using subsoil, rather than surface soil.
13. Fill two pint jars with water.
14. Gently and slowly pour all of the water from a full pint jar over the surface soil sample. Let the water run through the funnel into the jar beneath.
15. In the same way, pour water from the other full pint jar over the subsoil sample.
16. Now, note which jar has the most water? _____
17. Therefore, which soil held the most water? _____

Explain why one soil held more water than the other. If you were growing plants in these two soils, which one would be able to hold the more rain water for later use by the plants?

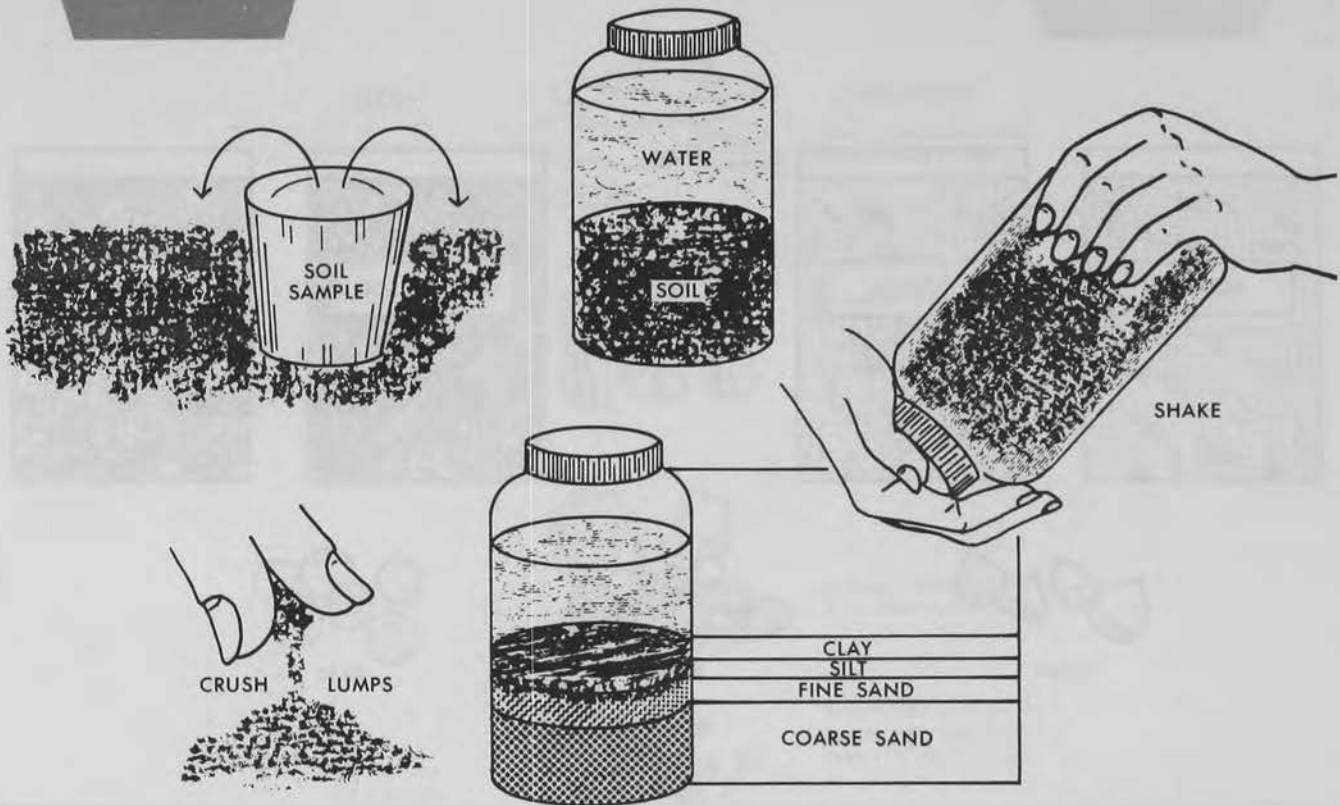
Subsoil _____

Surface Soil _____

*See explanation of surface soil and subsoil at the bottom of page 3.

Exercise IIB-7

The Amount of Clay in Surface Soil and Subsoil*

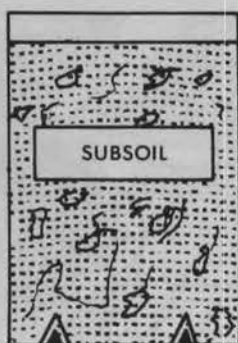
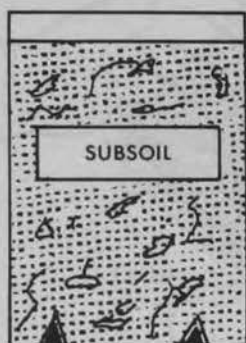


1. Use a quart of surface soil* and a quart of subsoil* collected in the previous exercise *or* as described in Exercise IIB-6.
2. Fill two quart jars $\frac{2}{3}$ full of water. Label them "surface soil" and "subsoil."
3. Pour 1 cup of finely crushed surface soil into the jar labeled "surface soil."
4. Pour 1 cup of finely crushed subsoil into the jar labeled "subsoil."
5. Add 3 tablespoons of non-sudsing detergent (dish washer detergent) to each jar.
6. Cover the jars tightly and shake hard, at intervals, for at least 5 to 10 minutes or until the soil particles are broken apart.
7. Place the jars where they will not be disturbed for 24 hours.
8. Observe the coarse soil particles settling rapidly. You may need to add some sand to silt loams and silty clay loams as all of the particles are small.
9. After 24 hours of settling, place a piece of cardboard beside each jar and carefully make a mark to show the thickness of each layer of settled soil.
10. Which jar has clearer water (the jar with the surface soil sample or the one with the subsoil sample)?
11. Give the approximate thickness of the layer of sand from the surface soil sample. _____
12. What is the approximate thickness of the layer of sand from the subsoil sample? _____
13. Therefore, which soils have the most sand? _____ silt? _____ clay? _____
14. Can you explain why the surface soil has different proportions of sand, silt and clay than the subsoil?
Repeat this exercise with soil samples taken from different places. You will most likely find interesting differences in samples taken from ditch locations, a beach or sand heap, your garden, or a field that grows good crops.

*See explanation of surface soil and subsoil at the bottom of page 3.

Exercise IIB-8

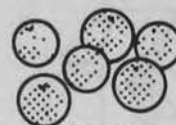
Ability of Surface Soil and Subsoil to Grow Plants



CORN




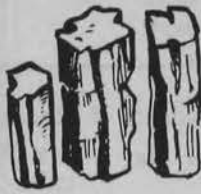
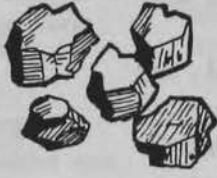


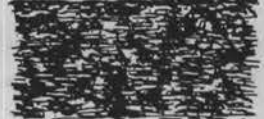
BEANS



PEAS

1. Use a quart of surface soil* and a quart of subsoil* collected in Exercise IIB-6.
2. Select four containers, such as the bottoms of cut-off milk cartons, tin cans or flower pots. Punch holes in bottoms for drainage.
3. Label two containers "subsoil" and fill with finely crushed subsoil.
4. Label two other containers "surface soil" and fill with finely crushed surface soil.
5. Select corn, beans or other similar seeds.
6. Plant four seeds in each container, about 1½ inches deep.
7. Pour water over the soil until it begins running from drainage holes in bottom.
8. Add water as needed to keep the surfaces moist. Keep in a warm, well-lighted place.
9. Keep the following record for two months:

	Surface Soil	Subsoil
Date planted:	_____	_____
Dates seeds emerged: . .	_____	_____
No. of days to germinate:	_____	_____
How many seeds came up?	_____	_____
Did the plants stay green?	_____	_____
Was there a difference in the number of seeds germinating in the two soils? _____ If so, how do you account for this? _____		
Was there any difference in the color or vigor of plants in the surface soil and subsoil? _____ If so, write down the difference with any explanation you have for this difference.		
ADDITIONAL ACTIVITY: Stop adding water to the containers. Observe the plants and record your observations on any differences noted.		
*See explanation of surface soil and subsoil at the bottom of page 3.		

<u>TYPE</u>		<u>DESCRIPTION</u>
PLATY		Flat, thin plates lying horizontally in soil.
PRISMATIC		Columns vertical in soil may be several inches long and 1 1/2 to 3" in diameter.
BLOCKY		Angular blocks 1/2 to 2" in diameter.
GRANULAR OR CRUMB		Resembles crumbs or grains. Usually less than 1/4" in diameter.
GRAVEL OR SAND		Soil particles do not stick together. Single grains.
HEAVY SOIL		Soil in very large clods. No visible structure. Hard to break apart.

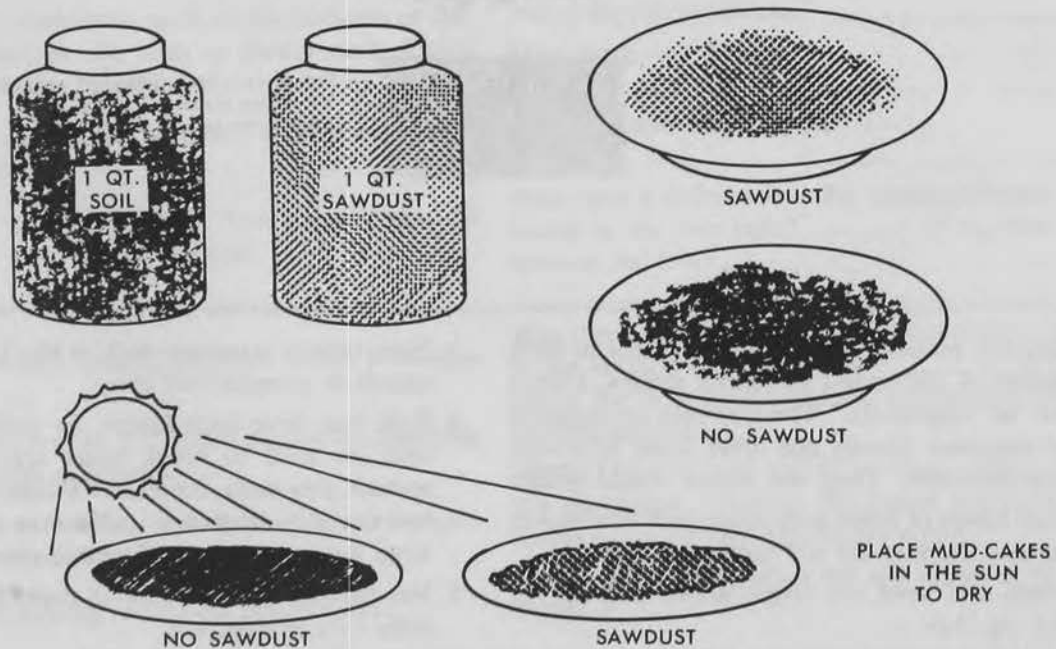
Individual soil particles are grouped together to form larger pieces of soil called structural groups, known as "peds" or "aggregates." The way they are grouped is called structure. (Sandy and other loose soils may not show structure. They are called single grain).

1. Break lumps of moist soils apart with your hands and note the way the soil breaks up.
2. Gravel and sand are single grains and do not stick together.

3. Note type of structure such as blocky, prismatic, crumb or granular and platy.
4. Soils that have large lumps, no visible structure and are hard to break apart are usually fine texture clay soils. Excessive tillage, working the soil too wet, or heavy traffic may also produce large lumps or a lack of visible structure.
5. Record on a separate sheet of paper how different soils vary in structure.

1. Collect a quart of clay soil and a quart of sawdust.
2. Label a paper plate "sawdust" and another "no sawdust."
3. Moisten 1 cup of soil until it will make a mud cake. (If the soil does not hold together, get a soil with more clay.)
4. Place the mud cake on the plate labeled "no sawdust."
5. Moisten and mix thoroughly $\frac{1}{2}$ cup of soil and $\frac{1}{4}$ cup of sawdust until they make a mud cake.
6. Place the mud cake on the plate labeled "sawdust."
7. Place both plates in the sun and let the mud cakes dry.
8. Record your observation when they are completely dry. Break the mud cakes with your hands. Which cake crumbled easier? _____ How would you explain this?
9. Record your observations. Also, explain how you could improve the physical condition of a soil.

ADDITIONAL ACTIVITY: Make this comparison between soil from a plowed field and soil from an adjacent fence row that has been in grass for several years. Also, compare the soil on the bare school play yard with the soil along a fence or wall that is covered with grass. Record your observations as you did above.



Exercise IIB-11

Physical Condition of Soils (Tilth)

You should do Exercises IIB-7, IIB-8, IIB-9 and IIB-10 before trying this exercise.



Good Tilth



Poor Tilth

*Tilth is influenced by moisture when the soil has been worked, by the rainfall rate (puddling), and even by the soil itself.

The physical condition of a soil sums up what we have learned in previous exercises. This condition is called "tilth." Tilth is due largely to the proportion of sand, silt, and clay, organic matter supply and past management practices*.

1. Use a spade or shovel to turn up a sample of a soil from the top 6 inches.
2. Crumble some moist soil between your fingers or, if necessary, break it up with a hammer on a board or hard surface.
3. Write your opinion as to the physical condition (ease of handling of the soil). Also, write your opinion as to the cause of any problems observed, such as low organic matter, high clay or silt, improper management, poor drainage, etc.
4. Repeat steps 1, 2 and 3 with at least five soils that have different vegetation or other surface appearances or visual differences. It would be well to try this in different areas of the state or even in other states when you travel. Attach your records and observations to this exercise for later use.

Exercise IIB-12

Using an Acidity (ph) Indicator



1. Put one teaspoonful of bottled grape juice in a large glass. (More frozen juice will be needed.)
2. Fill the glass with water and mix thoroughly.
3. Add one teaspoonful of baking soda to a glass of water. Stir until the soda is dissolved.

4. Add the baking soda solution, drop by drop, to the diluted grape juice until it turns light blue or purple. Why did it turn light blue or purple?
5. Now add vinegar drop by drop until it turns back to pink. Why did it turn pink?
6. Try other common materials such as lemon juice and washing powders to test for acid (pink) or basic (blue). Use a fresh supply of grape juice for each test.
7. Try other plant pigments, such as beet juice and the juice of red cabbage, to determine acidity or basicity (alkalinity).
8. Explain in your own words how plants develop pink and blue colors.

Nature displays an array of colors: red beets, yellow bananas, blue plums and green leaves. Blue, violet and certain reds are caused by plant pigments called anthocyanin. And as you observed above, the color will vary with the acidity or alkalinity of the plant sap.

The familiar fall leaf colors: red, yellow and brown occur when the green chlorophyll is destroyed.

Exercise IIB-13

Collect a Soil Sample for a Chemical Test

You can have your soil analyzed for lime and fertilizer requirements. See your local agricultural Extension agent for instructions for local conditions or use the following suggestions:



Figure 1

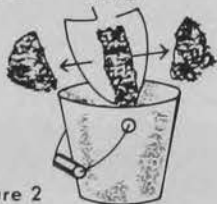


Figure 2

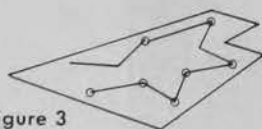


Figure 3



Figure 4



Figure 5

1. Spade out a V-shaped hole in the soil (Fig. 1).
2. Slice off a thin piece of soil on one of the sloped surfaces.
3. Put the center of the slice in a pail (Fig. 2).
4. Take several samples to represent the area of soil to be tested (Fig. 3).
5. Mix the soil thoroughly in the pail (Fig. 4).
6. Fill a soil container or clean jar (Fig. 5).
7. Fill in the information requested on the sheet when supplied.
8. Send to a soil testing laboratory. See your agricultural Extension agent for the appropriate address.
9. When the results of the test are returned, you can study the suggested fertilization with your leader or a person that they suggest.

The Importance of Soil

List 25 ways that soil is important to you. Include such things as growing lawns, trees, food, fiber, food for animals, support for your house, road bed, etc.



1. Visit fields, creeks, gullies, road cuts, streams or places where rocks may be exposed. This exercise will not apply in rock free areas such as the Corn Belt.
2. Collect six or more fist-size samples of rocks. Use a hammer to break off pieces of large rocks. Only smaller rocks may be found in some areas. Select rocks with freshly broken surfaces. Avoid those with weathered or decayed surfaces if possible.
3. Collect a small bottle of the clay, sand and gravel found near each rock where possible.
4. Label all rock samples and the bottles of soil.
5. Using the information given below, make a table and record the most appropriate description of each rock sample.

Color – Give color of fresh surface

Luster – Metallic, glassy, pearly, resinous, greasy or silky

Hardness – Can be scratched by fingernail, copper penny or knife blade

Form – Crystals, fibrous, platy or granular

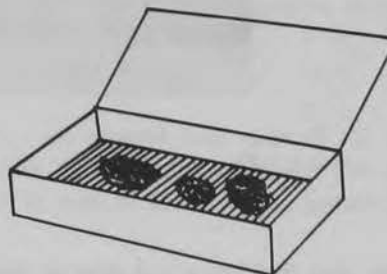
Cleavage when broken – None, plate like, right angles (cubic) or other than right angles

Fractures on Surface – Smooth like glass, uneven, fibrous, splintery or other

Tenacity (bends) – Brittle, elastic, malleable or flexible

Weight – Light, medium or heavy

6. Mount the collected samples in a suitable box.



(Use corrugated paper to line bottom of the box.)

1. Collect 20 or more Indian relics or other relics of past civilizations.
2. Label with interesting information such as the age, purpose for which the relic was used, where the material for the relic came from, etc.
3. Display in an attractive manner.

Rocks are the parent material of soils. Loess, glacial fill, and other sediments are the parent material in many areas. These materials are several steps away from the original "rocks". Therefore, excavations, streams, gullies, road banks, etc., give easy access to the lower soil depths and the parent material of some soils. The size, shape and position of the rocks give some indication as to the method of decomposition to form residual soil. Glacial areas will have scratches on the surface. Water-borne rocks will be worn smooth and the soil may be laid down in layers (sedimentary rocks). There may be little or no relationship between rocks and the transported soil around them.

(Not satisfactory where soils do not show visual color or texture differences for the area selected)



1. Select an area that has a soil map or one where you can see the differences in soils.
2. Make or get a map of the area showing the location of each different soil. Number each area.
3. Paste the map to a cardboard or veneer board.
4. Collect a pint of soil from each of the areas with different soil. Label according to the number on your map.
5. Let the soil dry. Break up the larger pieces as they dry out.
6. Screen out roots, trash, rock, etc. Use a window-screen wire or kitchen sieve.
7. Select one area of soil on your map.
8. Spread glue or rubber cement on the area selected in step 7.
9. While the glue or cement is still wet, sprinkle soil on the area and press.
10. Gently shake off excess soil when the glue or cement has dried.
11. Spray with lacquer or varnish to keep the soil from coming off the map.
12. Repeat steps 7 through 11 with the other areas.
13. In your record explain how soils differ even in small areas.

Additional Activity: Make a tracing of the soil map of a farm or area, if one is available. Write the name of each soil, a description and the use suitability. You could also determine limiting factors and favorable factors that would affect soil use.



To make a soil profile you will need: shovel, pocketknife, cellulose acetate cement, stiff cardboard (3½" x 9") and small cardboard chips (1" square).

Carefully select a site which represents the soil you wish to sample. This can be a roadcut, streambank or pit. Clean the bank back to the undisturbed soil. Mark off the soil horizons. These layers will differ in color, texture or structure. In the picture, the white lines on the soil are the boundaries between layers. The small white squares are pieces of cardboard used to sample each horizon.

With your knife, prepare a small, smooth sloping area in each horizon. Apply a thick coating of cellulose acetate cement to a cardboard square. Place the square on the prepared soil with the cement side toward the soil. The picture shows a closeup of the cardboard square on the soil bank.

After a few minutes, cut around each side of the cardboard square. Insert your knife blade in the soil under the square and remove it, taking ¼ to ½ inch of soil with the square.

Place a large drop of cellulose acetate cement on mounting board. Place cardboard square, with the soil up, on the drop of cement. The dried soil can be restored to natural color by covering with a thin coating of clear, commercial spray preparation.

If you wish, you can build a storage box for your soil specimens. With a saw, cut grooves inside the box so you can slide your cards into the box. On your mounting card, record: the date, collector's name, soil series, location, land use, rainfall, elevation, depth of soil, and its texture, structure. See exercise 17 (texture) exercise 9 (structure).

*There are several modifications of this procedure that are particularly desirable for specific conditions and purposes. See your County Extension Agent for any available adapted procedures for your conditions.



A. Preliminary Trials

1. Rub sand between your thumb and finger (beach sand or a child's sandpile). Note that it feels distinctly gritty.
2. Feel some flour between your thumb and finger. This is the way a silty soil feels.
3. Mix flour and sand together in equal amounts and feel between your thumb and finger. Try other combinations of flour and clay to get familiar with the feel of different amounts of the two. Modeling clay will show the sticky slick feel of clay.
4. If possible, get some practice with some soils of known texture and desirable moisture levels.
5. Collect several soils from different areas and number the soils 1, 2, 3, 4, etc.
6. Feel them between your thumb and finger.
7. Classify them as mostly sand, mostly silt, mostly clay or a combination of the three. You should now have the "feel" of soils and be ready to classify soil by texture.

B. Classifying soils by the texture of the surface soil

1. Use the soils in step 5 above. Put the soil number in the appropriate space of the following chart.
2. Record the texture classification you feel most appropriate for each soil (number).
3. Collect other soils from different surroundings.
4. Give each a number and record the location, and any other important information.
5. Repeat step 1 using the chart with the new soils.
6. Write a summary of what you have learned and include the record you made on the different soils.

SOIL TEXTURE	SAND	SANDY LOAM	LOAM	SILT LOAM	SILTY CLAY LOAM	CLAY
	1. Feel Loose, single grained Somewhat gritty Gritty Soft, smooth and floury Fine texture	X		X		X
2. Squeezed moist in the hand Crumbles when touched Forms last if handled carefully Forms cast (can be handled freely) Forms cast (wet or dry)	X	X	X	X		
3. Cloddy when dry Lumps broken easily Lumps hard to break Lumps very hard to break				X	X	X
4. Will form a ribbon when squeezed						X
5. Plasticity Slightly plastic and smooth Plastic and sticky when wet Forms heavy plastic; compact mass			X		X	X

See your leader for local requirements

4-H PLANT AND SOIL SCIENCE RECORD



Cut along this line

YEAR _____

(Name of Member)

(Age)

(County)

Address _____ Zip Code _____

Name of Parents _____

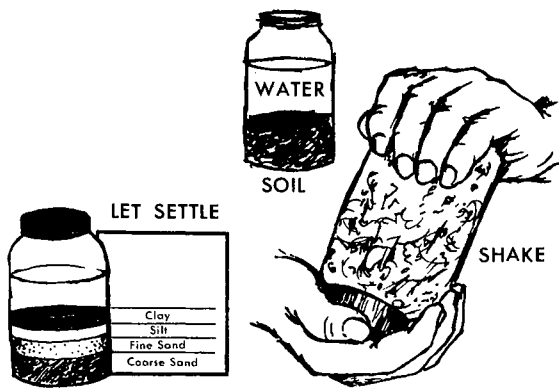
Name of 4-H Club _____ Years in Club Work _____

Name of Adult 4-H Leader _____

Address of Adult 4-H Leader _____

REQUIREMENTS FOR COMPLETING A 4-H PLANT AND SOIL SCIENCE PROJECT

1. Select the number of exercises your leader recommends.
2. Follow instructions for completing each exercise.
3. Use the outline your leader gives you to tell about your project. That on the next page is only an example.
4. Give your completed Science Record to your leader by the date requested. (Send to your agricultural Extension agent when you are not in an organized club.)



OUTLINE FOR 4-H PLANT AND SOIL SCIENCE PROJECT

(Use this outline to give information about each exercise and attach the material to this record.)

Exercise No. _____ Title of Exercise _____

Date Started _____ Date Completed _____

1. Write a short story about "What I did and what I learned by doing this exercise." Include things that you saw, anything that went wrong and things of special interest.

2. How did you get the supplies needed for this exercise?

3. State whether you did this exercise by yourself. If not, how many persons were involved. If other persons helped you, give their names and tell what they did.

Optional Signatures: _____

I have checked this Soil Science Project including exercise numbers _____ and found it to be satisfactorily completed.

(Signature of Leader or Parent)

I have checked this record and found it to be satisfactorily completed.

(Signature of Extension Agent)

DEFINITION OF TERMS

Anthocyanin — plant pigments that produce reddish color if the cell sap is acid; blue or violet, if basic (alkaline).

Acid — usually sour; sharp and biting to the taste (vinegar). Capable of reacting with a base to form a salt. Has a pH of less than 7.0.

Bacteria — minute plants.

Base — compounds capable of reacting with acid to form a salt. Has a pH greater than 7.0.

Basic — on the basic side of neutral (pH 7.0) (baking soda) (sweet or alkaline).

Clay — very fine soil particles; plastic when moist; sticky when wet; hard when dry; used for brick, tile, etc.

Crop — a plant or plant product that can be grown and harvested extensively for profit or subsistence (wheat, corn, soybeans, potatoes, etc.).

Drain — removal of water from the surfaces and/or through a soil.

Drainage — removal of excess water from a soil as by tile or ditches.

Field Testing — testing crop varieties, fertility of soils, etc., to determine their effect on yield or quality.

Erosion — wearing away of the earth's surface by the forces of water or wind (See Exercise IIB-5).

Fertilize (verb) — apply fertilizer to a soil to supply nutrients needed by plants.

Fertilizer (noun) — a material added to soil, occasionally to the plant foliage, to supply plant nutrient requirements.

Landscape — a portion of the earth that one sees at one time.

Lime — a basic material used to increase the pH of soils by neutralizing the soil acidity.

Organic Matter — fresh or partially decomposed plant and animal matter.

Profile — a vertical section of a soil exposing its various zones. (such as a high bank along the highway).

pH — a measure of acidity. 0 to 7 is acid and 7 to 14, basic.

Physical Properties (of soil) — different characteristics such as color, texture, consistency, depth, etc.

Sand — the coarser soil particles; example: beach sand.

Sandy — a soil containing a large percentage of sand particles.

Sawdust — particles resulting when a log or board is sawed.

Silt — relatively fine soil particles that are smooth to the feel (floury) that do not become slick and sticky when wet.

Sod — low-growing dense soil cover crop such as grass and grass-legume mixtures.

Soil — surface of the earth which supports life — the upper layer of earth that may be dug or plowed.

Soils, poorly drained — water is not removed because of a compact subsoil or the soil is too low for the water to drain out. The soil is usually a gray color within 6 inches of the surface.

Soils, well drained — water moves readily through the subsoil. They are not discolored but show good, bright colors throughout the soil profile.

Soil, bare — soil with no cover of growing plants.

Subsoil — a layer (stratum) of weathered material below the surface soil or topsoil.

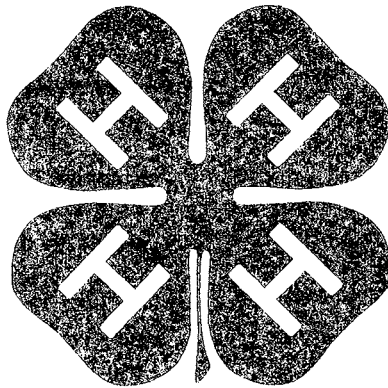
Structure (soil) — the arrangement of individual sand, silt and clay particles into clusters, chunks, peds, aggregates or compound particles (See Exercise IIB-9).

Surface Soil — surface soil to plowed depth or to a change in color or other characteristic.

Swamp — wet, spongy land; usually covered with water.

Terrace — soil deposited above present flood stage that has developed profile characteristics or rather distinct layers.

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“It is the policy of the Agricultural Extension Service of the University of Minnesota that all persons shall have equal opportunity and access to its programs and facilities without regard to race, creed, color, sex, or national origin.”

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