State of Iowa
1949

THE TEACHING OF CONSERVATION

IOWA ELEMENTARY TEACHERS HANDBOOK

Volume XIV

Grades 1-8

Issued by the
DEPARTMENT OF PUBLIC INSTRUCTION
JESSIE M. PARKER, Superintendent
Des Moines, Iowa

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FOREWORD

The conserving of our natural resources requires wisdom, vision, and devotion. These, in turn, call for adherence to a belief—a creed—by which one may chart his course and appraise his work. This beautiful creed is worthy of the thoughtful consideration of every Iowa educator:

I believe God created the earth by His divine processes for the benefit of man, not one man, nor one generation, but mankind for all time.

I believe the Almighty gave man an inheritance of the earth, not to be hoarded as a miser guards his treasure, but to be used with wisdom and in the fullest for the perpetual benefit of all men.

I believe all of mankind, regardless of race or creed are entitled to a fair and equitable share of the earth's bounty commensurate with their own efforts. But in so believing, I hold the irrevocable conviction that man himself owes earth a debt of respect and fealty.

I believe that whatsoever a man soweth, that shall he also reap; that he who manages his fields, pastures, woodlands, and streams with respect and wisdom shall reap the bountiful harvest and so shall his descendants; while he who uses them selfishly, thinking only of his own immediate gain, shall bring to grief his land, himself, and his children's children.

Holding these beliefs to be true I dedicate myself to the task of helping my fellow men realize their own personal responsibility in conserving the earth for the generations which follow them. To this end I shall devote my best knowledge in guiding the efforts of those who till the soil so that the land which nurtures us shall be fruitful without end.

For truly the earth is the Lord's and the fullness thereof, but the responsibility for its stewardship is vested in man.

C. W. GEE,
Soil Conservation Service,
Milwaukee, Wisconsin.

JESSIE M. PARKER,
Superintendent of Public Instruction,
Des Moines, Iowa.

WHY TEACH CONSERVATION?

Our Heritage We Prize

Ours was a rich heritage of natural resources—fertile land, clear lakes and streams, valuable minerals, thriving forests, abundant wildlife, and wide "fruited plains." We used these gifts in a spendthrift manner, not counting the inevitable cost of the spending nor foreseeing the future. We took little thought of generations to come who, too, had a birthright, a share of this trust fund.

Now, and almost too late, we see our lack of wisdom, our narrow vision, our unconcern for our fellow man and for posterity. The fertility of our farm lands in some cases has been woefully reduced through misuse and erosion; forests have been seriously depleted; mineral resources are becoming exhausted; wildlife suffers from unbalance or has become extinct; and many clear streams and lakes have disappeared, become dangerously polluted, or have been allowed to contribute to floods.

Recognizing our one-time disregard of the need to use all our heritage gifts wisely, we now recognize our obligation to maintain these gifts. We so commit ourselves when we take a stand in favor of conservation as opposed to economic waste and misuse.

Conservation Has Many Meanings

The first advocates of conservation may have been interested only in hunting and fishing and in keeping wide areas of forests and lakes in their natural state for recreational purposes. But that was a long time ago. Now only the unenlightened believe that conservation means only protection and saving of soil, wildlife, forests, etc.

Conservation has many deeper meanings:

It is acting upon a recognition that everything we eat, everything we wear, our shelter, our implements, our conveniences, and our luxuries — all come from the land.

It is a fascinating analyis of the simple terms of man's existence, of the interdependence and interrelationships of all things on earth, including man.

It is a social imperative of paramount importance—based on the belief that no individual or group has the moral right to waste our resources or to use them unwisely.

It is a feeling of personal obligation to transmit the gifts of our heritage to those who shall succeed us.

It is a way of living that appreciates and enjoys the out-of-doors.

It is a philosophy that projects itself into services looking ultimately to the preservation of *human* resources.

Conservation Is Not A New Subject

Conservation, like many another worthwhile cause, is always threatened by public ignorance or apathy. Consequently the task of teaching conservation is made more difficult. But educators dare not let that fact deter them. Conservation is not really a new "subject" — it is a comparatively new ideology, if you will, steadily claiming the attention of all thoughtful, forward-looking persons. Conservation by its very nature finds a place for itself in the curriculum of all schools and at all levels. Science, social studies, arithmetic, literature, and the arts are making contributions to it. The concept of conservation recognizes no

grade levels and no age limitations. It permeates all good teaching from kindergarten through junior high whether or not it goes by the name of conservation.

Conservation is a science, but it is so malleable and all-embracing in its concepts that it is a natural part of many other school subjects. One can hardly teach geographical regions, populations, effect of climate and rainfall, soil products, formation of the earth and its make-up without considering the true meaning of conservation.

History would be more truthfully taught if teachers recognized and stressed the fact that migrations of people, seizure of others' lands, plagues, and wars almost always have their origin in man's misuse of nature's resources. That these facts may not be found in history texts does not minimize their importance.

Most of the processes used in arithmetic could be taught through computation of the amounts of wastage and destruction which result from disregard of conservation principles. Dozens of genuine problems can be found.

Topics commonly taught in science as: insects, hibernating animals, fish, aquaria, plant life, bacteria—to name only a few at random—can be only superficially taught if conservation is not included. Conservation cannot be separated from any of these since all of them play a role in the balance of nature.

Conservation Is for All Grade Levels

The developing of proper attitudes toward conservation should begin with a child's first consciousness of the world of living things about him; with the first precepts of respect for personal and public property; with the wrongfulness of waste; with regard for the rights of others; with an awareness of our dependence on plants and animals; and with an awareness of beauty in nature. Good teachers have always stressed these things. But what an impetus will be given to the principles of conservation when teachers continue to do these same things but with the broad concept of conservation underlying their actions; in other words, teach with conservation aforethought.

Children even in nursery school can be taught to refrain from wasting food and supplies, based on a concern for starving children elsewhere, and the costs which will be felt on the family pocketbook. Such an attitude built in a child's early years paves the way for the desired attitude toward needless waste of any kind, both from an altruistic viewpoint as well as from an economic one.

In the primary grades pupils begin to develop concepts within their range of experience and understanding. Performing simple experiments, recording observations, looking at pictures, handling objects, and "talking things over" comprise most of their activities.

On the intermediate and upper grade levels similar experiences are provided, but more attention is given to the reading of materials within a wide range of reading ability—reading that calls for reasoning, judgment, and organization. Engaging in a variety of activities results in elimination of grade levels momentarily and prevents segregation of individuals into artificial classifications within a group. There are numerous opportunities for cooperative enterprises, all contributing to improved social living.

Classrooms commonly maintain various collections for science museums. Such practice is valuable. It provides aids for helping pupils to learn about the habits of wildlife and their adaptation to environment.

Firsthand Experiences in Conservation Are Desirable

One can hardly over-emphasize the importance of using the out-of-doors for a laboratory, and of making all possible use of firsthand experiences with the environment. Such experiences should be a part of every teacher's background and training.

The study of our resources in their natural setting can provide valuable experiences which can never be equalled within the four walls of a classroom. Numerous areas ideal for such learnings exist on every hand —woods, parks, streams, gardens, nurseries, eroded areas, reforestation projects, farms using conservation practices, hatcheries, water purification plants—to give only a few examples. Such experiences are not only the easiest way to achieve the wholehearted cooperation of children but they are the most potent means for indoctrinating children with the basic purposes of conservation.

Publishers of science textbooks are leading the way in helping schools to see that "Conservation is everybody's business." A number of series on the elementary level not only include conservation among the topics treated but they introduce it at *first grade* level. The content is readable and challenging. Much attention is given to practical activities dealing with objects in nature, with simple experiments, and with concrete suggestions for numerous activities that children will enjoy. Stress is on "learning by doing." There is a tendency throughout most of the texts to develop in children an appreciation of the interrelationships of soil, water, plant life, animal life, and human life.

Conservation Is the Concern of Urban Schools

The principles underlying conservation can not be the concern of rural schools only. Urban children must become familiar with the philosophy of true conservation and its urgency. It is imperative that *all* pupils understand how the wise use of soil, water, minerals, forests, and wildlife actually determines the permanence of both urban and agricultural life. All children are future citizens. All will be called upon to vote intelligently on measures related to the wise use, appropriate safeguarding, and continual development of our natural resources. All young persons now learn how the present came from the past; they learn their obligation to the leaders and founders of our country. They must be "indoctrinated" with a sense of obligation to use wisely the heritage of natural resources left them. They must be filled with a pioneering spirit and a desire to be active crusaders against reckless use of those resources. They must be presented with a picture of the troubles facing the world if the tenets of conservation are not believed and practiced.

Conservation Is Vital to Life

Children *must* learn, and adults *should* learn that no matter where a person may live he is affected by depleted soil. Foods, to be rich in health-giving nutrients, must have come from soils rich in such nutrients. Only healthy plants grown on healthy soil will produce healthy animals and ultimately produce people who are healthy.

If we teach conservation well, we shall rarely hear anyone say, "I live in a city, not on a farm—soil conservation means nothing in my life." Such persons will, instead, think to themselves: "The bacon and eggs and toast and fruit for my breakfast came from the soil; my cotton and wool and leather clothing came from the soil; the house I live in, the chair I sit on, the newspapers I read—all came from the soil. That soil is dis-

appearing, and I have an obligation to do something about it. I can't leave it to the other fellow—he may be even less aware of this obligation than I."

Teachers Must See The Need

It is easy enough to say to teachers in the elementary grades, "Teach conservation," but we cannot stop there. We know that if teachers are to achieve the desired aims of conservation education for youth they themselves must first be instilled with wholehearted belief in conservation's meaning and filled with the fervor of a crusader in projecting those beliefs into action.

A belief they might well adopt as a preliminary to inspiring children is expressed in the following Creed of Conservation:

> For land we love and heritage we treasure we pledge our strength, our knowledge, and our loyalty to wise use, careful preservation, and honorable transmission of our natural resources.

As teachers believe, so can they teach. As they are inspired, so can they inspire. The thing they work at continually is the building of good citizens—how better can it be done than through the teaching of conservation? Either we teach about conservation as opposed to waste and destruction and loss of life, or by implication we tacitly condone such wastages and loss by our silent acquiescence.

Conservation Practices Spring From Conviction

All children and youth should become imbued with the beliefs expressed by Dr. Aldo Leopold:

> "The practice of conservation must spring from a conviction of what is ethically and esthetically right, as well as what is economically expedient. A thing is right only when it tends to preserve the integrity, stability, and beauty of the community, and the community includes the soil, waters, fauna, and flora, as well as people.
>
> It cannot be right * * * for a farmer to drain the last marsh, graze the last woods, or slash the last grove in his community, because in doing so he evicts a fauna, a flora, and a landscape whose membership in the community is older than his own, and is equally entitled to respect.
>
> It cannot be right * * * for a farmer to channelize his creek or pasture his steep slopes, because in doing so he passes flood trouble to his neighbors below, just as his neighbors above have passed it to him. In cities we do not get rid of nuisances by throwing them across the fence onto the neighbor's lawn, but in water-management we still do just that.
>
> It cannot be right * * * for the deer hunter to maintain his sport by browsing out the forest, or for the bird-hunter to maintain his by decimating the hawks and owls, or for the fisherman to maintain his by decimating the herons, kingfishers, terns, and otters. Such tactics seek to achieve one kind of conservation by destroying another, and thus they subvert the integrity and stability of the community." *

* Reprinted from an article "The Ecological Conscience," by special permission from The Bulletin of The Garden Club of America, September 1947 issue.

Schools Must Point The Way

Conservation will never really make the progress it could and should until education has instilled in the minds of America's citizens the basic concepts underlying conservation, and the conviction that concerted, informed action is vitally necessary to human existence.

Since education in conservation is fundamental to life, it is the obligation of everyone to practice and to pass on its precepts. But our democratic society has the right to expect those dealing in education to point courageously at society's faults and to propose remedies for those faults. It is education's business, not to tell people what decisions to make, but to educate them so they will make the right decisions in the light of complete information and with the proper attitudes, insight, and understanding. This "complete information" refers to the best possible use of every drop of water, every inch of soil, every plant with all its parts, and every living creature. It means, also, there must be an understanding of their relationship to each other.

We are constantly reminded that technology is not the answer, even though experts may go to unprecedented measures in creating artificial substitutes for natural subsistence. The only answer is in educating people to a universal acceptance of the need to cooperate with nature—to use and to restore our natural living resources.

Public Opinion Must Be Molded

Not only must the philosophy and the principles of conservation be taught, but a steady advance must be made in informing and reforming public opinion.

If each person acted as well as he knew, there might not be this urgency note sounding in conservation education. But our actions in the past have shown we do not thus act, and our natural bounty has been too lavishly spent. Then, too, there are many who do *not* know and, therefore, cannot act with wisdom regarding the wise use and careful preservation of our precious resources. That fact points up the obligation of educators even more persistently. We must see that schools make known the facts of our resources inheritance, and the possible choices for action with their resulting consequences. Schools must see that *all* persons—children, young people, and adults—are aided in establishing values which will balance the selfish desires of today against an acute awareness of the needs of the future.

Desirable Outcomes Will Result

The results we expect from teaching conservation can be far-reaching and permanent. Since it is the children and youth who will benefit most from such a teaching program it seems not too visionary to set our sights high and expect to arrive at the ideal in results.

The "ideal" results are many and varied:

Pupils will develop a complete understanding of the interrelationships of soil, water, plant life, and animal life.

They will know that wherever they live, they will always be dependent upon the wise use of soil, forests, water and minerals; that whatever way they make a living in adult life, that living must take into account the use of natural resources.

They will take fewer comforts and luxuries for granted. Their knowledge of their indebtedness to many forces of nature and to

many persons around the earth will make them more appreciative of the blessings received in this state.

As pupils become conservation-minded, by their very beliefs and actions they will help to influence the actions of others, in conserving, restoring, and perpetuating our natural resources.

Pupils will carry over into their adult life the principles of conservation. These will be manifested in wise legislation, honest enforcement, improved recreational facilities, civic-mindedness of a high nature, and greater love for the out-of-doors, a reverence for the silent power and magnificence of Nature as she works incessantly for our good.

Pupils will achieve, as a final, ultimate by-product, a fuller, richer life.

All these desirable outcomes from the teaching of conservation imply intelligent and aroused leadership—the kind we can expect from teachers once they have become convinced of their role in this humanitarian cause. As teachers teach what they believe, conservation education will become an indispensable part of the school curriculum. The thousands of classrooms all over our state are the most potent fields for developing an awakened public conscience regarding conservation of our resources.

HERITAGE

By Arthur Guiterman

This is the land that we love; here our fathers found refuge,
Here are the grooves of their plows and the mounds of their graves;
These are the hills that they knew and the forests and waters,
Glorious rivers and seas of rejuvenant waves.

Fruitful and broad are the billowing plains that they left us,
Mossy and cool are the trails that we tread as they trod,
Grand are the ranges and deep are the echoing canyons,
Holy and pure are the peaks as the altars of God.

This is our heritage, this that our fathers bequeathed us,
Ours in our time, but in trust for the ages to be;
Wasting or husbanding, building, destroying, or shielding,
Faithful or faithless—possessors and stewards are we.

What of our stewardship? What do we leave to our children?
Crystalline, health-giving fountains, or gutters of shame?
Fields that are fertile, or barrens exhausted of vigor?
Burgeoning woodlands, or solitudes blasted by flame?

Madly we squander the bounty and beauty around us,
Wrecking, not using the treasure and splendor of earth;
Only is grief unavailing for glory departed—
Only in want do we count what the glory is worth.

Now let us heal and restore where we trample and plunder,
Cleansing and saving our shallowing rivers and rills,
Lending new life to the fields we have ravaged and beggared,
Calling new forests to gladden the desolate hills.

Then though we pass from the land that our fathers bequeathed us,
Mountain and river and wood shall our message renew—
"This is the land that we loved; oh, be faithful, our children!
Fair was it left to us; fairer we leave it to you!"

SUGGESTIONS TO TEACHERS

This Handbook is your guide in teaching conservation in all elementary grades, one to eight inclusive. We believe you will find it helpful if you will follow its plan.

It is based on a three-year cycle. Pupils re-studying a topic after three years will be able to study more advanced material and do more mature activities than was possible when the content was previously studied.

Teachers in rooms containing several grades will find it wise to follow the conservation units in this Handbook for each school term rather than to follow a science text. You will then be using the texts on all levels whenever they are indicated in the references at the end of each unit. In this way each text will be completely used before the three-year cycle is over.

Whenever it proves practicable, teachers of rural schools should plan to have all pupils working on the *same topic* of science whether a conservation unit or some other topic. Where units contain subject matter too far advanced for certain ages such units can be studied by those able to understand the ideas involved. All ages need not always have classes together. Sometimes the teacher will wish to work with the primary, intermediate, and upper grade levels separately, using materials and techniques suitable to those levels. At other times, all pupils can sit in on a class discussion from which all can profit, even though some only listen.

Where a teacher of one or two grades follows a science textbook, it is hoped that she will correlate the topics in that text with the conservation units that best fit. If the topic is bird study, she will find it a natural thing to turn to the unit on Conservation of Wildlife in this Handbook and stress the conservational aspect of bird study.

It is urged that all teachers observe the *three-year cycle* in selecting the conservation units in order to give their pupils a well-rounded course in conservation.

At the end of each unit in this Handbook suggested topics from the Handbook of Science and Nature Study are listed. It is hoped that teachers will teach these during the term the conservation unit is being taught.

The following suggestions may be of help in teaching these units:

1. Take plenty of time *before* the unit is launched to read the entire unit thoroughly.
2. Collect all possible references suitable for your particular pupils.
3. Skim these to ascertain content.
4. Put markers in the referred pages or post reference and pages.
5. Determine which pupils because of their reading ability will be referred to certain references.
6. Check the study questions that you feel your pupils will be able to discuss.
7. Check the extra activities that your pupils will be able and eager to do.
8. Procure all possible picture sets, film strips, slides, etc., that deal with the topic.
9. Prepare a supply table holding tag board, poster paper, construction paper, paste, colors, crayons, paints, brushes, wrapping paper, thumb tacks, paper fasteners, etc.
10. Put all books, pamphlets, picture sets, etc., on a special table or shelf to be kept there during the study of the unit.
11. Arrange a bulletin board that relates to the unit. Have it show

something of special interest. Have it ready the day the unit is launched.

12. Take time to make the approach and present the problem as the unit shows. Adapt it to your particular school situation.
13. Get as much participation as possible from pupils in raising questions for study. Use others besides the ones listed if they are pertinent.
14. Put study questions on large sheets of paper. Post them where pupils can see them at all times.
15. Help pupils to know that:
    a. Replies to all questions *will not be found* in all references.
    b. Answers to questions *may not* be found in the order in which questions are listed.
    c. Several references need to be read to find complete information.
16. Encourage pupils to do these while they are studying:
    a. Take brief notes but not copy whole sentences verbatim.
    b. Read carefully so as to report accurately to the class.
    c. Read more than one reference.
    d. Use study time to prepare something to illustrate oral reports to the class. Suggest a large drawing, or painting, or diagram or chart, etc. (Use materials on the supply table.)
    e. Keep a list of all unfamiliar words related to the unit. These should be added daily to a large vocabulary chart or a page in the "Class Book."
    f. Adopt a scientific attitude about their reading and their actions.
    g. Find and show pictures from references to supplement reports.
    h. Make something with the hands relating to the unit.
    i. Work together in planning murals, working experiments, providing equipment, giving reports, making displays, etc.
    j. Listen for radio reports dealing with unit studied.
    k. Give current events dealing with unit studied.
    l. Assemble a scrapbook of timely pictures and clippings.
17. In working with first and second grades the teacher will do much reading aloud about the topic being studied. She will show many pictures and make all information clear to pupils. She will give pupils many opportunities to talk over the information she has read to them. In addition they can:
    a. Dictate composite stories for her to write on the blackboard.
    b. Copy these stories for the "Class Book" or an individual science book.
    c. Draw pictures to illustrate stories read to them or composed by them.
    d. Look at picture sets and older pupils' reference materials.
    e. Look at stereoptican views.
    f. Do some experiments.
    g. Learn poems and songs connected with the unit.
    h. Bring materials for bulletin boards, collections, and displays.
    i. Act as audience to reports of older pupils.
18. Give occasional short, oral check-up tests, or snappy, one-word-answer tests in place of long, subjective, end-of-unit tests.
19. Let pupils keep the bulletin board related to the unit changing and stimulating.
20. Encourage pupils to seek information from persons outside the classroom.

21. Encourage exhibits, collections, displays, and experiments of various kinds.
22. Review occasionally the more important aspects of the unit studied.
23. Give pupils frequent opportunity to use the new vocabulary connected with the unit studied.
24. Stop work on the unit before pupils become disinterested.
25. Plan with pupils on how best to culminate the unit. Suggestions given at the end of each unit in the Handbook are *examples* of the type that can be given. Each classroom will be an individual situation.

CONSERVATION UNITS OF THE THREE-YEAR CYCLE

First Year of Cycle

Fall 1949, 1952, 1955—Conservation of Soil
Winter 1949, 1952, 1955—Conservation of Wildlife
Spring 1950, 1953, 1956—Balance in Nature

Second Year of Cycle

Fall 1950, 1953, 1956—Conservation of Mineral Resources
Winter 1950, 1953, 1956—Conservation of Forest and Timberlands
Spring 1951, 1954, 1957—Water Conservation and Flood Control

Third Year of Cycle

Fall 1951, 1954, 1957—Maintaining Soil Fertility
Winter 1951, 1954, 1957—Farm Conservation Planning
Spring 1952, 1955, 1958—Legumes and Grasses

Unit I — CONSERVATION OF SOIL *

Fall — 1949, 1952, 1955

Part I — Our Dependence on the Soil

I. TEACHER'S OBJECTIVES:

A. To help pupils realize that they are dependent upon the soil for their three basic needs: food, clothing, and shelter.

B. To help pupils understand that in order to have good schools, good roads and good churches soil must be conserved.

C. To have children believe that civilization progresses, survives, or disappears along with the fertility of the soil.

D. To show instances where, through unwise use of the land, man has brought about hardships and suffering to mankind.

II. PROCEDURE:

A. Approach and presentation of problem:

Teacher will read to pupils:

All of us in Iowa are proud of our state. We know that out of Iowa each year come millions of pounds of meat, grain, and dairy products to help feed half the people of the world. It is largely because of our rich, black soil and our favorable climate that we are able to produce the things we and other people need.

When our pioneer ancestors came to Iowa, they found this a land of treasure. Deer and bear by the hundreds found homes in the woods. Wild turkeys in huge flocks found roosting places in the trees. Wild ducks and geese lived richly in our lakes and streams. Passenger pigeons flew across the sky in huge swarms. Prairie chicken, partridge, pheasant, and quail reared their young in abundance. Fish by the thousands swam in the clear streams. Iowa was indeed a beautiful land.

There was such an abundance of all our natural resources (soil, water, minerals, plants, and animals) that those early Iowa pioneers used as much of everything as they wanted. It was necessary for them to kill some animals for food and for furs, but often they killed many animals just for sport. They needed to cut down some forests to get logs for buildings and fences. But they did not do much about planting more trees to replace the ones cut down. They burned forests so that the land could be plowed for crops.

When the forests disappeared many animals lost their homes. As swamps were drained to get additional farm lands, ducks, geese, and fish lost their homes. Thousands of acres of tall prairie grass were plowed under. There were no barren hillsides then, no ditches or gullies to mar the landscape. Because the soil was rich, no one ever thought it could wear out. But year after year as the same crops were planted on the same acres the soil did wear out. Rain and snow began to wash down hills and slopes where trees once had grown. Rills appeared, widening into ditches and deep gullies. Portions of farms washed away into rivers; waters overflowed river banks and washed away good farm land. Winds blew away topsoil on wide areas where roots of prairie grasses had once held the soil firm. Here is the way some of our land began to

* This unit has five parts. References are listed at the end of the unit rather than at the end of each part because the topics overlap.

look. (The teacher should have some good pictures of soil erosion areas to show the pupils.) Just think of it, more than one-third of the precious topsoil in Iowa has disappeared.

"What has all this disappearance of the soil to do with us?" you may ask. Just this: It affects you in respect to the three most important things in all life—food,clothing, and shelter. All your food comes from the soil, as well as all your clothing and your shelter. And where the soil is lacking in certain important elements, even the food you eat will not give you the right kind of nourishment. People and animals can actually starve even though they seem to be eating food in sufficient quantity. What the soil gives to the food it produces is the important thing.

Without soil there can be no soil-loving plants of any kind, no trees, no grains, no orchards, no pasture for cattle and sheep that provide us with leather and wool, no food of any kind. Louis Bromfield says, "We owe the good earth an infinite debt. Once it is washed and blown away it is gone forever, and in its place come starvation, floods, and economic ruin. It is precious to every citizen, not only to the cultivator of the soil, but to the banker, the industrialist, the artist, the working man, the shopkeeper,—for the well-being of all of them is based upon the good earth."

What can you as children do to help save this good earth? Everyone, no matter how small, can do something. You surely will want to learn what you can do so that you will be working to *build*, rather than to *destroy* soil. In your thinking you can begin with your own homes. What things would you like to have in your homes that you do not now have?

1. Teacher lists on the blackboard the remarks of the pupils. Draw from them suggestions that will probably include:
   a. For the new or remodeled home—painting, repairing, refurnishing, electricity and electrical equipment, etc.
   b. For the barn and outbuildings—new buildings, repairing, painting, electricity and electrical equipment.
   c. For the farm—fencing, drainage, machinery and equipment, lime, fertilizers, etc.
   d. For the family—clothing, new automobile, recreation, travel, etc.
   e. For the community—good churches and good schools, better roads, theaters, parks, swimming pools, baseball diamond, etc.

2. Where will your parents get the money to buy these things that you want and will need? (Enlarge upon pupil observation that on farms money will come from the sale of crops and livestock. Emphasize that the soil is the original source of all income which can be used to procure these needs. For children who do not live on farms show that the income derived by their parents is largely dependent upon the soil, too; that if the farmer has good crops, he will have more money with which to buy the goods or services from those who do not live on farms.)

3. Discuss how not only the money to buy things but also the basic products from which they are made come from the soil. Use an automobile as an example: Get from pupils all the different materials in a car first. List these on blackboard. Then get from pupils where these materials come from. The following might be listed:

a. Steel from iron mines.
b. Rubber for tires from rubber trees or synthetic rubber made of petroleum products.
c. Wood from forests.
d. Glass from sand.
e. Cloth upholstering from cotton or wool.
f. Leather from animals.
g. Plastics from soybeans, wood, etc.

We shall see that we are dependent upon the soil for most of our needs. If our soil is lost through unwise use, we shall suffer such hardships as poverty, undernourishment, lowered educational standards, and loss of many of the luxuries and comforts to which we are accustomed. If we help to preserve and build up our soil we shall all have more of all products that we need. In attempting to understand our relationship with the soil we shall try to find answers to the questions I shall put on the board for you.

B. Topics for Study and Discussion:

1. How is our soil being misused?
2. How is our soil being lost?
3. What evidences of erosion can be seen near our school?
4. Talk to your parents and grandparents about own county, township, or school district to find instances where farms have become eroded, gullied, or otherwise harmed by unwise use of the soil.
5. Study, through reading and pictures, instances where whole areas of our own country have declined, forcing people to move to other areas or live on in poverty, disease, and ignorance. (Cite examples of Tennessee and Kentucky mountaineers, New England's abandoned farms, the "Georgia Crackers," "Tobacco Road," the migrating "Oakies" and "Arkies," "Grapes of Wrath.")
6. Discuss these facts about the Mississippi River.
    a. 1,000 freight cars an hour each loaded with 40 tons of earth are equal to the amount of soil and silt carried by the Mississippi River each hour.
    b. New Orleans was originally located on the shore of the Gulf of Mexico. Now it is located 75 miles from the Gulf. (Show on map.) Much of the soil that makes up this Mississippi Delta was once producing crops on our Iowa farms.
    c. In many places along the lower Mississippi, the river bed has been filled up with the silt, and the dikes have been built higher and higher until the level of the water is above the level of the surrounding land. Disastrous floods are thus certain to occur when the dikes break. (Similar situation along the Yangtze River of China.)
7. How do farm lands in your county compare with what they were like when the pioneers first came?
8. Why should men, women, and children living in town be concerned about soil erosion and do something about conservation?
9. Can you visualize what things besides soil are floating down our muddy rivers?

C. Suggestions for Pupils' Other Activities:

1. Take a field trip to discover examples of soil waste in your community.
2. Work arithmetic problems illustrating the decrease in income resulting from soil waste.
   a. In 1941, one 80-acre field produced 60 bushels of corn per acre. In 1940, the same field as a result of loss of soil through erosion and overcropping produced 35 bushels per acre.
      (1) How many bushels less were produced in 1940 than in 1910? (Ans. 2,000 bushels less.)
      (2) At 75 cents per bushel, the farmer's income was how much less in 1940 than in 1910? (Ans. $1,500 less.)
      (3) If corn is 75 cents a bushel and the yield is 60 bushels per acre, how many acres of corn will it take to buy a $1,000 automobile? (Ans. 22.2 acres.)
      If the price is 75 cents and the yield 35 bushels per acre, how many acres will it take to buy a $1,000 automobile? (Ans. 38.1 acres.)
      (4) An inch of topsoil weighs 140 tons an acre. How many tons of topsoil are in a 40-acre field where the soil is 7 inches deep? (Ans. 39,200 ton.)
      (5) If there are 140 T. per inch of top soil on an acre of land, how many acres of topsoil are being lost each day by erosion down the Mississippi if this river carries soil down stream at the rate of 40,000 T. per hour? (Ans. 979.2.)

Make a survey of the school grounds or fields and roadways near the school for evidences of loss of soil by erosion.

Part Two

Nature of Soil and How It Has Been Formed

I. TEACHER'S OBJECTIVES:

A. To arouse an interest in soils through pictures, reading, school experiments, and discussions.

B. To have pupils learn how soil is made.

C. To teach facts about topsoil and subsoil that will enable pupils to see the necessity for conserving the former.

II. PROCEDURE:

A. Approach and presentation of problem:

Teacher and children will go outside with a spade and dig holes in several places—in the school yard, in a nearby field, along a ditch bank where soil conditions might be expected to be different, such as on a hillside, on a sandy knoll, on the bottom, along a fence row. Spade a perpendicular slice off a roadside cut or ditch bank. Have pupils observe differences in layers, in color, in texture of soil. Have them identify topsoil and subsoil. Have pupils answer as many of these questions as they can:

1. How is topsoil formed?
   How deep is it?
2. What causes variations in its depth?
3. Why is the color of the topsoil different from that of the subsoil?
4. How does the subsoil differ in nature from the topsoil?
5. Would subsoil be good crop land? Why not?

Where pupils' answers are lacking in information and accuracy, teacher shows them the reason for the study and discussion that will be forthcoming as they learn about the nature of soil.

B. Topics for study and discussion: Read to find:

1. Answers to questions above.
2. What is soil made of?
3. How have soils been formed? Explain each way.
   a. Weathering
      (1) Wind
      (2) Running streams
      (3) Heat
      (4) Freezing
      (5) Glaciers
   b. Other agencies
      (1) Plants
      (2) Animals
      (3) Man
4. How are basic rock materials converted into productive soil? By addition of
   a. Decayed leaves and grass
   b. Roots
   c. Decayed bodies of animals
5. How are rock particles and organic matter (decayed plants and animals) mixed? Explain each.
   a. Earth worms
   b. Moles
   c. Gophers
   d. Man
6. What kinds of soil will result from these various actions? Show samples. Describe each.
   a. Gravel (tiny rocks—no organic matter—not fertile)
   b. Sand (small rock particles which have a gritty feel)
   c. Silt (finely divided soil particles which feel like talcum powder)
   d. Clay (very finely divided soil particles which cause soils to be sticky when wet)
   e. Peat (mostly organic matter deposited by plants in marshes)
   f. Loam (a mixture of sand, silt, clay, and organic matter)
7. What different kinds of soils are there in your school district? How do these differences affect the yields of crops?
8. How do you account for the differences in the *profile* of our soil?

C. Suggestions for pupils' other activities:

1. Plant seeds in pots or cans filled with different kinds of soil and from different layers and observe results.
2. Have pupils draw to scale profiles of soil from holes or from a ditch, or a roadside cut, showing varying depths of topsoil.
3. Make tests for topsoil depths at various places and report results.
4. Illustrate weathering by rubbing two pieces of soft stone together.
5. Bring smooth stones from a stream or jagged stones showing scratches.

Part Three

Causes of Soil Waste and Deterioration

I. TEACHER'S OBJECTIVES:

A. To have pupils study soil erosion and its effects on the land, streams, and lakes.

B. To acquaint pupils with the various practices responsible for soil waste.

C. To show that through the neglect of drainage systems and poor land use much land is improperly drained. Such land yields poor crops.

II. PROCEDURE:

A. Approach and presentation of problem:

If possible, teacher and pupils visit a field or yard where one or several of the following can be observed:

1. Sheet erosion
2. Gully erosion
3. Over-grazing
4. Poverty grass and ragweed
5. Poor drainage

Where these cannot actually be visited, show pictures of these situations and discuss their causes, remedies, and implications. Consider the following questions:

1. What has caused the loss of soil from this field?
2. Why have weeds grown so profusely in the pasture?
3. Why does water stand in fields that formerly drained well?

Where an actual field or yard is visited:

1. Note the color of the soil on the slope and at the bottom of the hill.
2. Measure the depth of topsoil near the top, at the middle and bottom of the slope, along a fence row, or in a nearby wooded area.
3. Account for the difference in the color of the soil and the depth of the soil.
4. What evidences are there of other kinds of field erosion?

Where the above approach is not possible, use pictures to show and explain different kinds of erosion.

a. Geologic—Show pictures of Grand Canyon
b. Accelerated
   (1) Caused by
      (a) Wind
      (b) Water
   (2) Kinds
      (a) Sheet
      (b) Rill
      (c) Gully

B. Topics for study and discussion. (Use pictures as much as possible. Help pupils to find information given below):

1. What factors contribute to erosion?
   a. Overcropping (depleting organic matter)
   b. Up and down hill plowing
   c. Clearing timber from steep slopes
   d. Overgrazing
   e. Fall plowing of slopes
   f. Burning straw
   g. Prairie fires
   h. Forest fires
   i. Climate

2. What are the effects of erosion?
   a. Removal of productive topsoil
   b. Silting of
      (1) Drainage ditches
      (2) Reservoirs
      (3) Artificial lakes
      (4) Fertile lowlands
   c. Polluting of streams
   d. Extensive property damage
   e. Loss of water in the soil

3. Discuss the effect which continuous cropping or poor farming will have on erosion and on drainage.
4. Have pupils discuss with their parents or old settlers the changes which have taken place in the farms of the community during the past 20-40 years. Discuss this in class.
5. Discuss this statement: Man's *unwise* use of the axe and the plow has ruined our country.

C. Suggestions for pupils' other activities:

1. Build up two separate mounds of soil. On one make furrows that run up and down the hill. On the other make furrows that run around the hill. Sprinkle lightly the same amount of water over each to find out which loses more soil.
2. Cover one mound with sod and leaves. Leave the other bare. Sprinkle water on each slope. On which is the loss greater? Why?
3. Visit a gully which is forming. Measure the depth at a marked spot and place a stake at the head of the gully. Observe again at a later date and note difference in depth and distance the gully had advanced up the hill.
4. Have each pupil draw a map of a farm, field, or yard, locating

in colored pencil the running streams, dry creeks, gullies, and ridges.

5. If lands are level, draw a map showing the location of drains and project tile lines that need to be laid.
6. Make a model in the sandtable of some farm in your school district—show topographical features of the farm, soil conservation practices, etc.

Part Four

Conserving Soil and Water

I. TEACHER'S OBJECTIVES:

A. To impress upon pupils that soil and moisture conservation is a dire necessity.

B. To help pupils become familiar with the various practices for conserving soil and moisture.

C. To teach so effectively that pupils will feel a personal obligation to do something about saving soil and water.

II. PROCEDURE:

A. Approach and presentation of problem:

We have been studying about the nature of soil, the formation and kinds of soil, and reasons why soil is lost. Now we want to consider what can be done to prevent further loss of soil and to build up soil for the future. What practices in conserving soil have you actually seen done? What practices have you seen pictures of? What practices have you heard about only? (Let pupils give as much information as they can.)

(Teacher names each method of conservation shown or named and lists each on the blackboard.) List will include:

Reforestation	Controlled grazing
Dams	Re-seeding pastures
Shelterbelts	Farm woodlots
Listing	Contour plowing
Crop rotations	Terracing
Use of fertilizers	Grassed waterways

(Teacher should show a picture of each method mentioned. Note whether there seems to be gaps in their understandings. Note what questions seem to arise from this discussion. List such topics for further study.)

Some of these ways of conserving soil are not familiar to you, perhaps. You will find it interesting to read about them and to find more pictures to illustrate them. Other topics for study relating to these practices will be listed on the blackboard.

B. Topics for study and discussion:

1. Why should we conserve soil?
2. What are some good ways of conserving soil?
3. List advantages and disadvantages of each procedure.

a. Reforestation
b. Dams
c. Shelterbelts
d. Listing
e. Crop rotations
f. Use of fertilizers
g. Controlled grazing
h. Re-seeding pastures
i. Farm woodlots

4. Why is water necessary in soil?
5. What is the water table? What affects it?
6. Explain a water cycle.
7. How can a water table be maintained?
8. Why is maintaining a water cycle important? (Be sure that pupils understand that the amount of water present in the soil year after year and the distribution of that amount through the seasons determine the amounts and kinds of plant life. These in turn determine the type of agriculture to be practiced, the abundance and variety of wildlife, and the general health of the land.)
9. Explain ways of controlling water by drainage.
   a. Land may be drained by open ditches or tile.
   b. Some drainage systems already installed may not be functioning because of:
      (1) Poor construction
      (2) Silting in ditches
      (3) Bad outlets
      (4) Poor physical condition of soil (depletion of organic water through excessive cropping)
10. What are the effects of straightening a meandering (crooked) stream?
11. Why does water filter through some soil much more rapidly than others? Demonstrate. Explain.
12. Why can the government through PMA afford to pay a farmer $1.50 per acre for contouring corn?

C. Suggestions for pupils' other activities:

1. See pictures, slides, or films showing how farmers are putting soil conservation practices into effect.
2. Take field trip to observe how farmers are practicing soil conservation.
3. Dig up a plow-length twelve-inch-square of sod growing several kinds of legumes and grasses, wash out the soil and compare the amounts of root system.
4. Remove tops and bottoms from several tin cans. Tie muslin over the bottoms. Fill several cans about ¾ full of different types of soil: loams, sand, clay. Pour same amount of water on top of each can of soil and observe variations in rates at which water runs through the soil. Also check variations in amount of water which runs through each type of soil.
5. Visit farms in the neighborhood where conservation work has been done. Notice such practices as grass waterways, pasture improvement, contouring, strip-cropping, terracing, etc. During art periods, draw illustrations of some of the practices you have observed.

Part Five

Individuals and Groups at Work on Conservation

I. OBJECTIVES:

A. To impress upon the pupils that soil conservation is *every person's concern.*

B. To acquaint pupils with individuals and groups who are actually helping with conservation problems.

C. To show pupils how farmers are securing help from these individuals and groups.

D. To impress upon the pupils that the responsibility for using conservation practices lies chiefly with the farmer or land owner but that other agencies are ready and willing to assist.

E. To create a desire on the part of every pupil to do something about conservation.

II. PROCEDURE:

A. Approach—Discuss with the pupils the following questions:

1. What can anyone on a farm do to conserve the soil *without* the help of other individuals or groups?
   (possible answers)
   a. Rotation
   b. Fertilization
   c. Grassed waterways
   d. Contouring

2. What conservation practices that are needed on farms require the help of *other* individuals or groups?
   (More complex—usually need help in laying out contour lines)
   a. Contouring
   b. Terracing
   c. Strip farming
   d. Gully control

3. Have the pupils relate orally what has been done on farms in their community. Determine if conservation agencies helped.

B. Pupils working in groups or with teacher:

1. From the following list, check the organizations found in your *county* which are concerned with soil conservation. Opposite the name of such organization give the name of the person who is in charge of this service.
   a. Soil Conservation District
   b. Soil Conservation Service
   c. State Conservation Commission
   d. Extension Service
   e. Farm and Home Administration
   f. Production and Marketing Administration, (formerly AAA)
   g. General Farm Organizations
   h. Future Farmers of America

i. Vocational Agriculture
j. Friends of the Land
k. Sportsmen's Groups
l. 4-H Clubs

2. Ask some member of one of these agencies to show some conservation films at your school. Invite the parents.
3. Make a collection of books and pamphlets on soil conservation. List names of authors and titles under the heading "Our Library on Conservation."
4. Examine all books, bulletins, and pamphlets to determine the groups which wrote or supplied this material.
5. Have individual pupils talk to people who are members of the groups listed above and report to the class the work accomplished by each.
6. Invite the local Soil Conservationist, County Extension Director, or interested farmer to talk to the school about the work of his group.
7. Find pictures from newspapers, farm papers, or magazines of men who have done outstanding work in conservation. Mount on a large sheet of paper and below each write the contribution of that individual.
8. For a bulletin board display find articles that tell what various organizations are doing in soil conservation.
9. Discuss advantages in having groups of farmers working together on soil conservation rather than each individual working on the program alone.
10. Discuss why it is important to have all organizations working together on soil conservation problems.
11. Discuss the question: "Should schools teach soil conservation?"

SOIL CONSERVATION ACTIVITIES WITHIN SOIL CONSERVATION DISTRICTS (IOWA)

The following is a brief account of Soil Conservation activities in Soil Conservation Districts in Iowa.

1. District Commissioners, elected by landowners within the district, develop the program and work plan for Soil Conservation activities within the District, and direct the "carrying out" of such activities. They are the governing body of the Soil Conservation District.
   a. Under the direction of the State Soil Conservation Committee.
   b. With the assistance of agencies, groups, and individuals.
2. District Commissioners solicit the assistance of agencies, groups, and individuals who may be in a position to aid in carrying out the District's activities.
3. Facilities of the district are offered by the Commissioners to groups and agencies in carrying out definite conservation projects and activities that may be undertaken by such groups or agencies.
4. Agencies may enter into a memorandum of understanding or agreement with the District Commissioners setting out the responsibilities of each. The following are examples:

a. The State Extension Service has entered into a memorandum of understanding with each organized Soil Conservation District in Iowa. Their primary responsibility is to assume active leadership in carrying out the educational activities of the District.
b. The Soil Conservation Service has entered into a memorandum of understanding with each organized district in Iowa. Their primary responsibility is to assist farm owners and operators in planning and applying conservation measures on the land.

5. Other esamples of cooperative activity and other types of assistance.
   a. In some Districts, the commissioners have invited a committee of one individual from each group and agency to aid in planning and carrying out district activities.

      The above committee meets periodically with the District Commissioners to plan activities and to aid in developing ways and means of carrying out activities of the District, thus assuring that all phases of conservation are receiving proper consideration.

   b. The Soil Conservation District furnishes to groups and agencies such aids as technical information, visual instruction materials, field training by way of tours, discussion groups, etc.

Teachers and pupils should consult the Soil Conservation District Office for further information. The District offices are generally located in the county seat town.

D. Culmination of entire unit:

Give a program, preferably to adults, about conserving soil. Pupils can share with their audience the most important knowledge they have acquired. They can display art work connected with the unit, demonstrate experiments with soil and water, show scrapbooks, discuss a bulletin board project, explain a picture exhibit, etc.

GLOSSARY

Accumulation—Collection. Gathering together.
Alluvial—Land deposited by water.
Atmosphere—The air surrounding the earth's surface.
Bacteria—Tiny organisms present in air, water, soil, plants, animals, man, and all living organisms. Some are beneficial; others which are harmful, give rise to many and various diseases. They are so small that tens of thousands may be contained in a single drop of water.
Boulder—A large stone worn or rounded by the action of water or ice.
Buffer Strip—An unplowed strip of meadow or pasture land left in a plowed field to reduce the speed of water running across the field.
Calcium (Lime)—A chemical found in soil. Used by plants as food. Important in bone building.
Carbon Dioxide—A gas found in air. Breathed out by man and animals and taken in by plants.
Composition—The make-up of anything. What is in it.

Compost—The piling of vegetable matter to rot quickly for fertilizing purposes.

Compact—Pressed closely together.

Conservation Farming—Cultivating and caring for land in a manner that will maintain or increase the fertility, obtain a high crop yield and prevent the loss of soil from the land. The maximum return with the minimum of soil loss.

Contour Farming—Farming on the level across the slope.

Cropping—Farming operations including preparation of the soil, planting the seed, cultivating and harvesting the crop.

Diversion Ditch—A waterway so built as to cause rain water to flow in a new location. Usually built around the upper end of a gully.

Drift Soil—Soil deposited by glaciers during the ice age.

Erosion—Wearing away, as water wearing away soil rock particles.

Eroded Area—Any part of the field where the soil has been worn away by wind and water.

Evaporate—To change into vapor, that is, into moisture in the air.

Fertile—A soil is said to be fertile if it produces good crops with a minimum of labor and expense. Capable of producing abundantly.

Fertilizer—Any substance that will increase growth and production of plants.

Geologic Erosion—The slow process in nature that wears away the land. Carried on by glaciers, ice, snow, water, and wind.

Glacier—A slowly moving body of ice and compacted snow.

Granular—Composed of grains or containing grains.

Green Manure—Any crop plowed under while green and for the purpose of improving the soil.

Gully—A deep channel or ditch cut by running water.

Humus—The material in soil caused by the decay of roots, stems, and leaves of plants and the decay of flesh, bones, and manure of animals.

Hydrogen—A gas found in the air we breathe. Also one of the parts of water and other substances.

Inorganic Matter—Material other than animal or vegetable matter.

Leaching—Soluble particles being dissolved in water and seeping away.

Legume—Any plant such as peas, beans, clover, alfalfa, etc., that has the ability to utilize nitrogen collected from the air by bacteria which live in nodules on its roots.

Limestone—A rock composed of calcium carbonate.

Listing—The planting process where soil is ridged and seed is planted in the depressions between ridges.

Loess (Luss)—A wind deposited soil.

Micro-organism—A tiny living thing.

Murky—Cloudy, not clear.

Natural resources—Those things furnished us by nature such as trees, plants, minerals, fish, animals, birds, soil, etc.

Nitrogen—A gaseous element making up about four-fifths of the air, when it is available in the soil; plants use it in development and growth.

Nodules—Small knots or nodes. When found on the roots of legumes, they contain nitrogen in form available for plant growth.

Organic Matter—Decayed material in the soil. Humus.

Overfall—Any place in a waterway or gully where the water falls over the edge and makes a vertical drop.

Oxygen—A gas found in the air. Breathed in by man and animals and given off by plants.

Phosphorus—A chemical found in soil and used by plants.

Potassium—A chemical found in soil and used by plants.

Profile—A picture or illustration showing kinds of soil at various depths.
Rill Erosion—Small depressions cut in the whole surface by running water. Usually only a few inches deep and spaced closely together.
Rotation Crops—Crops grown on the same field, one after another in an orderly sequence.
Sandstone—A stone formed by the cementing of sand particles.
Saturated—Completely filled.
Sheet Erosion—Uniform wearing away of a field.
Silt—Very finely divided particles of earth.
Silt Loam—A silt containing sand and clay.
Soil—Loose surface material of the earth in which plants grow.
Soil Conservation—A term applied to methods used to reduce soil loss due to erosion.
Sod Waterway—A low place in a field, covered with grass sod, used to collect water and direct it off the field without erosion. A grass waterway.
Terrace—A ridge and channel built across the slope of a field to direct surface rain water to waterway at a very slow speed.
Texture—Size of particles—the "feel".
Topography—The physical feature of a region.
Topsoil—The rich upper part of the earth's surface.
Underground Water—Water held or moving in the rocks and soil below the earth's surface.
Vegetation—Plants.
Water Cycle—A round of events wherein rain falls on the land, is absorbed by plants or runs to the sea, is evaporated into the air, is drawn into clouds, and then falls on the land again for another round.
Weathering—Action of wind, water, etc., in changing color texture, composition, and form of exposed objects.
Wildlife—All birds and wild animals living in the fields and timber.

III. REFERENCES:

A. Science Textbook Series:

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With Jane and Paul 149-150

Curriculum Foundation Series.....Scott, Foresman and Co.
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My Land and Your Land Conservation Series.....
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The Seasons Pass 212-223
The How and Why Club 225-235

Wonderworld of Science Series.....Scribner's
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- How and Why Conclusions 106-130, 290-297

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- Book Five 213-235
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B. Miscellaneous:

The following references deal with all five parts of the Unit on Conservation of Soil. Therefore, pages are not listed for any particular topic. Please refer to these references, also, when studying *all the units*, as there is much worthwhile information to be found in them.

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Darling	Poverty or Conservation—Your National Problem	Nat. Wildlife Fed., Washington, D. C.
*Dougan	Stories of Outdoor Science	Lyons & Carnahan, Chicago, Ill.
Extension Serv.	Your Three Acres	Okla. A. & M. College, Stillwater, Okla.
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*Fenton	The Land We Live On	Doubleday Co., Garden City, N. Y.
Fonda	The Lord's Land	Friends of the Land, Columbus, Ohio
*Green et al.	Your Homeland	Webb Pub. Co.
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*Green et al.	The Thirsty Earth	Webb Pub. Co.
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John Deere Co.	Soil Conservation	John Deere Co., Moline, Ill.

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Peterson	Let's Save Our Soil	Agri. Ext. Serv., Iowa State College, Ames, Ia.
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Rhyne & Lory	Conservation of Natural Resources	Chas. E. Merrill Co., Columbus 15, Ohio
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* Can be secured from The I. S. E. A. Library Service, Shops Bldg., Des Moines, Iowa.

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From Ridge to River

New Landmarks of Soil Conservation

Our American Land—The Story of Its Abuse and Its Conservation, Misc. Pub. No. 596

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Use the Land and Save the Soil, What Is Soil Erosion, Misc. Pub. No. 280

Newspapers and Magazines

Iowa Conservation Magazine
Iowa Farm and Home Register
Iowa Farm Science
My Weekly Reader
Successful Farming
The Iowa Bureau Farmer
Farm Bureau Spokesman

Encyclopedias

Britannica Junior Encyclopedia
Compton's Pictured Encyclopedia
The World Book Encyclopedia

State Departments of Education

Write to the various State Departments of Education for pamphlets and bulletins dealing with conservation of natural resources.

Picture Sets

Creative Educational Society, Mankato, Minn.	"Conservation of Natural Resources." Packet of 119 black & white photographs 8½ in. x 11 in. Explanatory text on the back of each picture. Teacher's guide book included. f.o.b. Mankato $12.50.
Our Great Out-of-Doors	A portfolio of 30 famous cartoons by J. N. Darling. Published by Iowa Division, Izaak Walton League, 732 Fenelon Place, Dubuque, Iowa, $1.00.

Topics in the Handbook of Science and Nature Study that are suggested to be taught in the same term as the unit on Conservation of Soil.

Topic	Pages
Starting New Potted House Plants	19-20
Making an Outdoor Bulb Garden	21-22
Making a Nature Map of Neighborhood	25-26
Making Individual and School Gardens	80

Unit II — CONSERVATION OF WILDLIFE

Winter — 1949, 1952, 1955

This unit is confined to fur bearing animals, game birds, and song birds. It is recommended that other topics which come under this heading, e. g., waterfowl, reptiles, and amphibians, be studied at this time.

Part I — Conserving Our Fur Bearing Animals

I. TEACHER'S OBJECTIVES:

A. To help pupils understand that the preservation of fur bearing animals is important in our country.

B. To teach pupils the value of fur bearing animals even though not many persons depend directly upon them for a living.

C. To teach ways in which fur bearing animals may be protected and where desirable, increased in our country.

D. To teach pupils that the restoration of abundant fur bearing animals will create a national resource of great value to our country.

II. PROCEDURE:

A. Approach and presentation of problem:

To be read to pupils by the teacher:

Some three hundred years ago the first settlers came to this country. They found America a land of dense forests, fertile plains, timbered mountains, and beautiful streams. Many kinds of wild animals, birds, and plants found homes in these forests and on the fertile plains. The rivers and lakes were full of fish. Many animals lived near streams and in the mountains. Wildlife seemed to exist in this new land in unlimited numbers. You have read stories of the huge herds of bison that thundered across our prairies. The forests were the homes of many kinds of deer, elk, and bear. Antelope grazed on the grasslands. Flocks of mountain sheep and goats lived among the crags of the mountains. Our ponds and streams were the homes of many busy beavers and muskrats.

Where have all these animals and other forms of wildlife gone? It is true that men, in hunting, killed a great many. In cutting forests, plowing grasslands, and draining swamps they destroyed homes and food for many. Thus their numbers dwindled. Now we are asking ourselves what we can do to restore the wildlife that once lived so abundantly in America.

We shall find many interesting things about the wild animals of America during the early days and how the early settlers destroyed many of them.

Do you wonder why there were so many wild animals in America before the white people came? Perhaps we could think of some reasons and list them later on in our study.

We have read that the many kinds of animals including birds and fish found in America were of great use to the Indians. Have we thought of the value of wild animals to people living in America now?

We shall want to find out ways in which abundant wildlife is

as valuable to us as it was to the Indians. We shall need to know ways and means of increasing wildlife so that it will add to our happiness and prosperity. We shall want to know what can be done to correct the mistakes which we have made in the past.

I think it would be helpful to list some questions on the board. We can then turn to our books for information which will help us to discuss and answer these questions.

B. Topics for Study and Discussion:

1. What fur bearing animals were found in America when the white settlers came? Make a list of those about which you have read.
2. Why were there so many fur bearing animals during the time the Indians lived in America?
3. Why did the early settlers destroy so many of these?
4. Tell how each of the following factors resulted in destruction of fur bearing animals in America in the early days.
   a. People in Europe wanted furs.
   b. Early settlers wanted land upon which to grow crops for food.
   c. Early settlers needed clothing and food.
5. Tell how each of the following results in destruction of wild life.
   a. Forest fires
   b. Draining of swamps
   c. Predatory animals
   d. Automobiles and good roads
   e. Hunting for sport
6. Can you name fur bearing animals that are pests to the farmers? How would planting a hedge row lessen the damage done to orchards and crops by these animals?
7. What kind of fence planting would be best on your farm? Name some plants you would want to plant in or near the hedge row.
8. Discuss ways in which farmers might consider all wild life, including wild animals, as a crop.
9. In what ways can the restoration of wild life in the country help people in cities and towns to make more money?
10. In what way can a dog help a hunter in preservation of wild animals?
11. Why are hunting licenses required?
12. In what way is the woodchuck a benefit to the rabbits?

C. Suggestions for Pupils' Other Activities:

1. Prepare an exhibit of photographs or pictures of wild animals that are native to Iowa. Write a caption for each picture, naming the animal, telling its habits and habitat. Write a short conversation story for each.
2. If possible, secure a copy of the hunting laws of our state.
3. Plant a hedge row on your farm. Make a census of wild life that is attracted to the hedge row.
4. What facts can you find about the value of each of the following in our state today?

a. Beaver
b. Muskrat
c. Silver Fox
d. Squirrel
e. Raccoon
f. Skunk
g. Wolf

5. Visit a produce dealer during the trapping season and find out what wild animals are being caught for furs. What value have these furs?
6. Write to the Iowa Conservation Commission for any literature which they may have about animals of Iowa.
7. Make a map of Iowa showing areas where larger wild animals may be found.

D. Culmination of Part I of Unit:

1. Make a scrap book about fur bearing animals of Iowa.
2. Prepare a program to give for parents or other pupils telling about fur bearing animals.

Part II — Conserving Our Winter Bird Life

I. TEACHER'S OBJECTIVES:

A. To instill in minds of children the necessity of helping birds to live during the winter.

B. To acquaint the pupils with the birds that live in their community during the winter.

C. To learn value of all winter birds in our agricultural life, and how these birds can be conserved.

II. PROCEDURE:

A. Approach and presentation of problem:

Begin by telling pupils about the winter birds you have seen thus far, mentioning some interesting facts about their appearance and behavior, and telling a true anecdote or two about some of them. Get from pupils all birds they have seen in Iowa in winter. (List on board.) Discuss whether some are here just for the winter, or if they stay here all year around. Mention migration briefly but leave study of it for spring unit. Show pictures of birds and see if pupils can identify birds that are found in Iowa *in the winter*. Encourage pupils to tell interesting facts about these from their own observation. Mention game birds but leave them to be studied as a group by themselves.

B. Topics for study and discussion:

1. Get children to discuss and to raise questions about habits of winter birds, whether they need our help, and how that help can be given, etc.
2. List such questions as these on board for study
   a. Why can birds keep warm in winter and need not hibernate or migrate?

b. Which birds of Iowa are permanent residents? Occasional visitors? Winter migrants?
c. Which birds are mainly insect eaters?
d. Which are mainly seed eaters?
e. Where is food for these birds obtained in winter?
f. Where do these birds sleep?
g. What enemies do they have?
h. Of what value are these winter birds to us?
i. How can we help to conserve them?

C. Suggestions for pupils' other activities:

1. Read to find answers to above questions.
2. Make a mid-winter bird census and catalog.
   (See units 29 and 30 in Iowa Elementary Teachers Handbook on Science and Nature Study.)
3. Discuss feeding stations.
   a. Where are they usually put?
   b. How constructed?
   c. What foods are put in stations?
4. Construct feeding station at school.
5. Observe and list kinds of birds feeding at stations.
6. Read aloud to class similar stories.
7. Write news items for school or local paper or "Iowa Conservationist."
8. Make sketches from observations.
9. Discuss bird banding. Report on readings about the topic.
10. Make a collection of photographs or sketches of Iowa winter birds.
11. Visit a farmer and get his opinion of value of winter birds to him.
12. Give a report of your interview to class.
13. Read and report about what has happened to the passenger pigeon and other early native birds.
14. Ask the teacher to read to class Longfellow's poem "The Birds of Killingsworth."
15. Make a collection of old birds' nests. Try to identify them. Note different materials used.
16. Make scrapbook of articles and pictures of winter birds.
17. Interview or write local paper asking it to run timely articles on conserving winter birds.
18. Learn what birds are protected by law and how protected.
19. Study Iowa's upland game birds
    a. Define game birds
    b. List common ones and where found in Iowa
    c. Discuss early history, eating and nesting habits, and behavior
    d. Discuss value to farmers and why game birds should be conserved
    e. Discuss how to attract and conserve game birds
       (1) Provide shelters—evergreens, densely planted bushes, tangles of vines, brush heaps, bean-pole tepees
       (2) Provide plants for their food—mountain ash, box elder, pines with cones, birch, sunflowers, dogwood, thorn-crab apple, barberry, black alder, jewel alder, jewelweed, pigeon grass

(3) Leave places for nesting and rearing young—
Wide strips of grass and small grain standing around edge of fields
(4) Prevent burning and pasturing of wide grassy fence rows, roadsides, ditches
(5) Leave high-cut stubble fields
(6) Encourage second-growth timber
(7) Provide feeding stations adjacent to thickets, groves, and other protective shelter
(a) Let harmless wild plants stand
(b) Leave a few corn shocks standing
(c) Leave several rows of corn standing
(d) Leave patches of soy beans, sorghum cane, and millet
(e) Scatter grain on ground
(f) Fill seed-hopper under brush
(g) Build three-sided lean-to's and place food there
(h) Construct a feeding shelter for upland game birds
Reference:
Scott and Hendrickson "Upland Game Birds of Iowa"

(8) Discuss the value of the following in the protection of winter birds:
(a) Fence row planting
(b) Fence corner
(c) Borders of field plantings
(d) Waste areas
(e) Pond borders
(f) Gullies
(g) Grass waterways

(9) After talking the above over with your parents, make a plan for spring planting of bird sanctuaries on your farm or on the school ground
(10) Call or write local conservation officer. Ask him to give talks, show films, etc.
(11) Ask the farmers to leave standing the first few rows of corn, wheat, alfalfa, timothy next to a woodland for food and protection for the birds. Be sure to explain to the farmer why this is important.
(12) Plant Rosa Multiflora for fence plantings in Southern Iowa
(13) Help post notices of new laws protecting birds and other wild life
(14) Make an upland game survey of your farm or on a neighbor's
(15) Learn to say in unison parts of the Wild Life Pledge
(16) Discuss how these conservation of wild life measures are related to conservation of soil

D. Culmination of Part II:

Plan and give an assembly program to which you invite parents or some other school. Use as your theme "How to Conserve Our Winter Birds." Display all your references, handwork, charts, written work, and other projects.

Part III — Conserving Our Song Birds

I. OBJECTIVES:

A. To develop an appreciation of bird life.
B. To discover the value of birds to us.
C. To learn how to protect birds.
D. To recognize our common songbirds.

II. PROCEDURE:

A. Approach and Presentation of Problem:

1. Do you know?
   a. That if all birds were to be destroyed, *within seven years man* and other animals would *begin to starve.*
   b. That a bird's stomach has contained 340 grasshoppers, 52 bugs, 3 beetles, 2 wasps, and one spider.
   c. That some birds travel 22,000 miles a single year.
   d. That a bird's skin does not get wet.
2. Show pictures, slides, films of birds and bird life.
3. List on board familiar song birds.
4. Encourage pupil conversation on song birds.

B. Topics for Study and Discussion:

1. How do birds differ from other animals?
2. Study the following bird parts: wings, feet, beak, plumage and its parts and sense organs.
3. How do nests differ? Materials, shapes, and location.
4. Find out about bird eggs, i. g., shape, size, color, and number.
5. What is bird migration?
   a. Where do they go?
   b. Do we know where they migrate?
   c. When do they leave?
   d. How far and at what rate do different birds migrate?
   e. What dangers are encountered?
6. Be able to recognize 20 songbirds in your locality.
7. What economic value do songbirds have?
8. Study ways to attract and protect birds.
   a. Feeding tray
   b. Bird baths
   c. Bird shelters
   d. Bird clubs
   e. Bird laws
   f. Bird houses
9. Make a list of interesting habits of birds.
10. How can we interest others in birds?
    a. By their beauty
    b. By their songs
    c. By their value
11. Explain meaning of: Migration, itinerary, ornithology.
12. How do birds protect themselves?
13. How are birds dependent upon the soil?
14. What trees and other plants do birds like?

C. Suggestions for pupils' other activities:

1. Field trip—Observation of birds, insects.
2. Chart arrival of various song birds.
3. Slides, movies, pictures.
4. Recognize birds by song.
5. List valuable birds.
6. Make bird booklets.
7. Make bird baths.
8. Take a bird census.
9. Plan a Bird Day Program.
10. Make a migration chart.
11. Make a free-hand drawing of birds.
12. List states and the state bird.
13. Hold a birdhouse show.
14. Make a bird calendar and bird itinerary.
15. Make reports—bird societies, bird banding.

III. REFERENCES:

A. Science Text Book Series:

GRADES 1-4 inclusive.

Adventures in Science Series.....Allyn and Bacon

With Judy and Joe	14-15, 19-20
	34, 36-37
	48-53, 56-57
	68, 74-76, 89
With Bob and Don	3, 15-18
	21-23, 27-31
	34-26, 39
	40-53, 56
	65-67, 72-75
	86-91, 97-98
	100, 108, 112
	114-115, 117,
	120-129
With Jane and Paul	3-4, 9-11
	17-19, 22-23
	28-38, 49-53
	69-78, 116-119
	123-126, 128-234
	145-146, 151-164
With Doris and Billy	43-52, 156-161
	175-183, 200-205
	209-229

Basic Science Education Series.....Row, Peterson and Co.

Animals We Know	All
Animals Around the Year	All
Birds in the Big Woods	All
Birds	All

Curriculum Foundation Series.....Scott, Foresman and Co.

Look and Learn	6-10, 13-22
All Around Us	3-28
How Do We Know?	4-36
Discovering Our World, Bk. I	10-63, 184-196

Nature Science Books.....Albert Whitman and Co.

Feathered Flights	All

Our World of Science Series.....Ginn and Co.

Science All About Us	45-65, 145-153
Science Through the Year	199-209
Science Every Day	33-87, 103-131
Exploring in Science	77-124, 273-277

Scientific Living Series.....L. W. Singer Co.

Sunshine and Rain	30-31, 72-81
Through the Year	5-11, 22-25
	28-29, 76-85
	92-95
Winter Comes and Goes	49-63, 98-101
	146-148, 201-205
The Seasons Pass	34-45, 71-79
	107-110, 140-155
	226-241, 250-253
	258-261, 270-273
The How and Why Club	44-67, 282-297

Wonderworld of Science.....Scribner's

Book One	9-23, 92-95
Book Two	7-35, 43-44
	47-54, 77, 111-114
	121-131, 142-143
Book Four	7-30

GRADES 5-8 inclusive.

Adventures in Science Series.....Allyn and Bacon

With Jack and Jill	45-60, 199-228
With Ruth and Jim	10-11, 17-23
	25-27, 53-67

Basic Science Education Series.....Row, Peterson and Co.

	273-295, 323-353
Saving Our Wildlife	All
Animal Travels	All

Curriculum Foundation Series.....Scott, Foresman and Co.

Discovering Our World, Book II	11-42
Discovering Our World, Book III	256-269

Iroquois Science Series.....Iroquois Publishing Co.

Science and You	61-72
Living with Science	302-312

Our World of Science Series.....Ginn and Co.

Working with Science	69-95, 305-349
New Ideas in Science	121-138

Science in Modern Life Series.....J. B. Lippincott Co.
Exploring Science 39-65, 435-442

Science in Our Modern World Series.....Macmillan Co.
Understanding Science 350-394
Science for Daily Use 393-396, 408-409

Scientific Living Series.....L. W. Singer Co.
How and Why Experiments 30-88, 301-302

Unit Study Books.....American Education Press
Conservation of Wild Life All

Wonderworld of Science Series.....Scribner's
Book Five 190-199, 241-242
Book Seven 278-283

B. Miscellaneous References (This list is not intended to be a complete one):

Author	*Title*	*Publisher*	*Pages*
Baynes	Wild Bird Guests	E. P. Dutton & Co., 286-302 4th — Ave., New York 10, N. Y.	Chap. 5 7, 8
Bronson	Wonderworld of Ants	Harcourt Brace	All
Bronson	The Grasshopper Book	Harcourt Brace	All
Bronson	The Chisel-Tooth Tribe	Harcourt Brace	All
Buck	Animals Through the Year	Jr. Lit. Guild	All
Chapman	Our Winter Birds	Appleton-Century, 35 W. 32 St., New York, N. Y.	All
*Comstock	Handbook of Nature Study	Comstock Pub. Co., 124 Roberts Place, Cornell Heights, Ithaca, N. Y.	294-415
Downing & McAtwee	Living Things and You	Lyons & Carnahan, 250 Prairie Ave., Chicago 16, Ill.	All
Edwards & Sherman	Outdoor Playhouse	Little, Brown & Co. 34 Beacon, Boston 6, Mass.	69-78
Encyclopedia Britannica Picture Sets	Selected Titles		
*Graham & Vandersal	Wildlife for America	Oxford Press	All

Author	*Title*	*Publisher*	*Pages*
Hawksworth	A Year in the Wonderland of Birds	Chas. Scribner's Sons, 597-599 — 5th Ave., New York 17, N. Y.	Chap. 4
Heathershaw & Baker	Wonders to See	World Book Co., 2126 Prairie Ave., Chicago, Ill.	229-270
Hogner	The Animal Book	Oxford	All
*Huntington	Let's Go Outdoors	Doubleday & Co., Garden City, N. Y.	
Hylander	Out of Doors in Winter	Macmillan Company, 2459 Prairie Ave., Chicago, Ill.	Chap. 3
Kimball & Webb	Birds in Their Homes	Jr. Lit. Guild	All
Lockwood	Golden Book of Birds	Simon & Schuster, 1236 — 6th Ave., Rockefeller Center, New York 20, N. Y.	All
Martin & Shepherd	Conservation and the School	Klipto Loose Leaf Co., 15-17 So. Delaware Ave., Mason City, Iowa	
Palmer	Cover	New York College of Agr. Ithaca, N. Y.	All
Patch & Howe	Outdoor Visits	Macmillan Company, 2459 Prairie Ave., Chicago, Ill.	69-79
Childcraft			
Compton Encyclopedia			
Junior Britannica			
World Book			
Scott & Hendrickson	Nesting Birds of Iowa	Iowa State College Ames, Iowa	All
Scott & Hendrickson	Upland Game Birds in Iowa	Iowa State College Ames, Iowa	All
Scott & Hendrickson	Winter Birds Around My Home	Iowa State College Ames, Iowa	All
Van Coevering	Real Boys and Girls Go Birding	J. B. Lippincott 227-231 So. 6th St. Philadelphia 5, Pa.	133

* Can be obtained from The I. S. E. A. Library Service, Shops Bldg., Des Moines, Iowa.

Topics from the Elementary Teachers Handbook of Science and Nature Study which are suggested to be taught with the unit on Conservation of Wildlife.

Topic	*Handbook pages*
Bird Census	49-50
Winter Bird Life	50-51
Prevention of Cruelty to Animals	51-52
Trapping, Hunting, Fishing	52-53
Bird Identification Chart	71
Bird Portraits	772
Bird Day Program	72-73
Birdhouse Show	73
Attracting Birds	73-74
Bird Calendar	74
Bird Migrations	75
Caring for Pets	86-87
Rearing Young Game Birds	88-89
Bird Nesting Census	89
Staging Pet Show	91
Hunting Wild Animal Tracks	23
Hunting Wild Animal Homes	24-25

Unit III — BALANCE IN NATURE

Spring — 1950, 1953, 1956

I. TEACHER'S OBJECTIVES:

To help pupils understand that:

A. Nature tries to maintain a balance among all forms of life.

B. Man is constantly upsetting this balance.

C. Animals and plants are interdependent; man is dependent upon both animals and plants; and plants, animals, and man are all dependent upon soil.

D. Plants and animals adapt themselves to their environment in order to survive.

E. Man must learn how to help Nature maintain a balance among all forms of life.

II. PROCEDURE:

A. Approach:

I wonder if you have thought about the close relationship that exists between all living things. Do you know that while all living things battle with each other for survival, they can not live without each other? Here are some statements that may be confusing to you but they are true: In early days trout disappeared from the streams because the settlers shot the wildcats. If you shoot too many owls you may not get honey. The more cats you have the larger and better should be your clover crop. Lions depend upon grass for their existence. Here are some ideas for you to think about to see if you can figure them out.

The clue to the explanation lies in your understanding of the way all living things, plants, animals, and man live together, battle with each other, help each other, and would die if they did not have each other. It is a fascinating story.

Think of any area where plants and animals are living together—a forest, a jungle, a meadow, a cornfield, a swamp, a farm, a pond. If any region is left to itself there is very little change in the numbers of all living things in that region. We say there is a balance between plants and animals—a balance in Nature. If some animals increase in number faster than there are plants to feed them we say there is an unbalance. If the number of plants is far greater than the number of animals, again there is unbalance. It seems as if nature has a plan to keep all living things in the proper balance. When this balance is greatly upset, then a number of serious happenings may result in the destruction of life, the loss of soil and water, loss of shelter, and loss of money and prosperity. These are a few examples. You will learn more about this further on.

You already know from your study of soil and water conservation, and of forest and wildlife preservation, that man is upsetting Nature's balance in many ways. He has over-hunted, over-grazed, over-plowed, over-cut, over-drained, over-raised—to name only a few things. He does not always realize how much he depends on his surroundings, and so, instead of fitting his ways of living to his surroundings, he tries to make his surroundings fit him. So he does unwise things that upset Nature's careful, wise balance. For example: A pond or stream is maintaining a bal-

ance between its animal and plant life. The water plants give off oxygen which the water animals need in order to live. These same animals give off carbon dioxide which the water plants need. Everything is in good balance until people allow silt and waste matter to enter the water. This waste and silt use up the oxygen and space needed by plants and animals. So they are either completely killed off or reduced in numbers. Man has upset Nature's balance.

Nature has arranged its own method of controlling waters through covering steep places with grass, trees, and decaying vegetable matter. These reduce the speed and amount of run-off. Then men burn the trees and grass and plow furrows up and down the slopes. Water rushes down the slopes in greater amounts and with greater speed. Here again man has upset the plan for keeping animal and plant life in balance. He must undo the harm (if he can) or learn new ways of living, or move away from his surroundings. When he works to make the balance of living things more nearly equal, we say he is trying to restore the balance of Nature. You will find, as you read, what things or conditions cause unbalance or restore it.

You know from your study of geography and science that both animals and plants must have certain environmental conditions in order for them to live where they do. One could not put *any* kind of animal in a region with *any* kind of plant life, or vice versa, and expect them to live and maintain a balance.

In time, some plants and animal can adapt (change) to their conditions but others never can. So there is found in every area what is called a plant community. In such community the animals and plants depend upon each other for their existence. Both depend upon the soil as you will learn. And people depend upon all three. Most of this relationship centers about food. Plants must have food—animals must have food. People must have food—as well as clothes and shelter which come from plants and animals. And so there has come to be what is called a food-chain.

A chain, as you know, is made up of links. What do you think a food chain is composed of? How many links would you guess most food chains have? A food chain is a number of living things grouped together because of what they eat. A food chain always starts with a plant. Here is an example: It begins with a pine tree (the plant). Plant lice eat the sap of the tree. Ladybird beetles eat the plant lice. Birds eat the ladybird beetles. All the different kinds of food chains in one area overlap. All of them together are known as a food web.

You will want to learn how people have caused this unbalance of Nature and how they are still continuing to do so. And then you will wish to find out how people can help to keep a balance in Nature. As you have learned in studying soil erosion, our mistakes in the past have been very costly, and this country has been ruined in places perhaps forever. If we can understand how this balance operates, then we can learn what must be done to remedy or to prevent this serious situation. Here are some questions for which I believe you will be interested in finding the answers. (Teacher will list the following topics for discussion on the board. She may also wish to ask pupils to raise other questions.)

B. Topics for Study and Discussion:

1. How do plants and animals change to fit themselves into their surroundings so as to remain alive?
   (a) Ways of getting food
   (b) Ways of getting shelter

(c) Ways of adapting to cold weather
(d) Protection from enemies
(e) Ways of escaping cold weather (migration, hibernation)

2. Explain "interdependence" in a community of people. Give examples in your own community.
3. Explain "interdependence" in a community of plants and animals.
4. What is a food chain? Give several examples. Explain "filling a niche."
5. Explain "herbivora," "carnivora," and "omnivora." Give examples.
6. What does "balance in nature" mean? Explain how an aquarium, a pond, and an ocean are "balanced."
7. Why was it possible for first colonists to America to find a balance in nature?
8. How did men upset this balance?
9. How did shooting of wildcats cause the trout to disappear from streams?
10. In what other ways have people upset Nature's balance?
11. What is being done *in your community* to upset Nature's balance? To restore it?
12. How do soil, water, and forests help to keep Nature in balance?
13. Explain ways in which birds are helpful in keeping a balance in Nature.
14. Are birds of prey mainly harmful or beneficial? Explain.
15. Discuss bounties. Are they a good way to help balance Nature? Explain.
16. Why isn't the earth overrun with plants and animals?
17. Explain how these help in balancing Nature: foxes, hawks, game birds, moles, squirrels, snakes, beavers.
18. Learn about fish and game laws in your state.
19. Should we look only to laws and restrictions to maintain a balance in Nature? Explain your answer.
20. Learn how insects are harmful.
21. Explain how insects are beneficial.
22. Explain this saying: "The more cats, the more clover."
23. Study some cycles in insect life—potato beetle, corn borer, Japanese beetle, butterflies, moths, etc.
24. How do earthworms help to make the soil fertile?
25. Explain how plants struggle to keep alive. How they help in the balance of Nature.
26. How do plants depend on water? On soil? On animals? On trees? On people?
27. Learn some of the services performed by bacteria.
28. What is being done in your area to *restore* the balance of Nature?
29. Show how the quality and abundance of plant life depend upon the quality, fertility, and abundance of the soil.
30. Show how the quality and abundance of animal life depend upon the quality and abundance of plant life which is directly dependent upon the quality, fertility, and abundance of the soil.
31. Why has Nature planned that animals and plants should produce eggs and seeds in such enormous numbers?
32. Can you explain giants and dwarfs among plants?

C. Suggestions for Other Pupil Activities:

1. Make a list of ways in which plants help animals.
2. Make a list of ways in which animals help plants.
3. Make a list of ways in which plants and animals help man.
4. Make a list of things in your community that are helping to destroy the balance of Nature.
5. Make a list of birds and animals that are protected by the laws of our state. Tell why these laws are necessary.
6. Draw a food pyramid.
7. Draw one or several food chains.
8. Illustrate, by drawings, Randy's story in HOW AND WHY CLUB, p. 104.
9. Name as many animals as you can that protect themselves from cold weather by each of these methods:
   1. By hibernating
   2. By storing food
   3. By migrating
10. Name as many animals as you can that protect themselves by each of the following methods:
    1. By being able to move fast
    2. By their color
    3. By resemblance to something else
    4. By armor of some kind
    5. By having weapons
    6. By some peculiar habit
11. Make a list of plant and animal partnerships that you have observed.
12. Bring to class pictures showing partnerships between living things of different kinds.
13. Tell the story of the disappearance of the passenger pigeon.
14. Tell what is being done to keep the American bison (buffalo) from becoming extinct.
15. Make a list of other wild birds and animals that are disappearing.
16. Talk to some persons who have lived a long time in your community to find out about the changes that have taken place in the number and kinds of wild plants and animals.
17. Explain how to make a balanced aquarium and if possible make an aquarium at your school.
18. Use these words in good sentences:

environment	herbivora
balance in Nature	omnivora
plant-community	extinct
food chain	parasites
predatory animals	adjustment
species	habitat
interdependence	termites
adaptation	lichens
carnivora	survive

D. Culmination of the unit:

1. Plan and give a program about balance in Nature.
2. Make a list of summarizing statements about important facts.
3. Assemble a frieze of drawings made by pupils.

4. Assemble drawings and give a "movie" with explanatory talks.
5. Select and give moving picture or slide films.
6. Make an exhibit using bulletin board display, picture books, and other materials.
7. Give an objective test.
8. Write and give a play dealing with the gained information.
9. Invite some person in to talk about balance in Nature.
10. Assemble a "class notebook."

III. REFERENCES:

A. Science Textbooks Series:

GRADES 1-4 inclusive

Adventures in Science Series.....Allyn & Bacon

Title	*Pages*
With Judy and Joe	8-11, 14-19, 34-35, 48-50, 53, 67-68, 86-88
With Bob and Don	22, 32-33
With Jane and Paul	9-11, 142-144, 170
With Doris and Billy	18-22, 23-28, 146-149, 199-205, 210-221

Basic Science Education Series.....Row, Peterson and Co.

An Aquarium	All
Useful Plants and Animals	All
Living Things	All
Seeds and Seed Travels	All
Plants Round the Year	All
Animals and Their Young	All
Garden Indoors	All

Curriculum Foundation Series.....Scott, Foresman and Co.

Look and Learn	3-21
All Around Us	3-28, 62-77
How Do We Know?	4-36, 54-72
Discovering Our World, Book I	9-45, 183-212

Nature Science Books.....Albert Whitman and Co.

Along the Creek	All
Life in An Ant Hill	All
Little Creatures with Many Legs	All
Story of Bees	All
Finding Nature's Treasures	All

Our World of Science.....Ginn and Co.

Science Through the Year	77-104, 151-164, 199-208, 211-219
Science Every Day	65, 80-100, 104-129, 219-241
Exploring in Science	77-103, 125-126, 214-221, 225-241

Scientific Living Series.....Singer Co.

We See	24-25, 32-45
Sunshine and Rain	28-57, 88-94

Through the Year	5-9, 26, 28-29 70-105
Winter Comes and Goes	5-35, 144-171 174-185, 199-200
Seasons Pass	41-63, 105-110
How and Why Club	44-68, 89-107
Wonderworld of Science.....Scribner's	
Wonderworld Readiness	13-26, 64, 79-89
Book One	9-20, 89-98 103-119
Book Two	7-31, 39-54 111-148
Book Three	164-181
Book Four	7-28, 153-165 185-204

GRADES 5-8

Adventures in Science.....Allyn and Bacon	
Title	*Pages*
With Jack and Jill	11-27, 31-42 45-60, 175-179 243-260, 263-278 281-286
With Ruth and Jim	3-33, 94 323-352, 357-380
Basic Science Education Series.....Row, Peterson and Co.	
Balance in Nature	All
Spiders	All
Adaptation to Environment	All
Curriculum Foundation Series.....Scott, Foresman and Co.	
Discovering Our World, Book II	11-42, 239-244
Discovering Our World, Book III	241-268
Iroquois Science Series.....Iroquois Publishing Co.	
Science and You	31-78
Living with Science	287-312
My Land and Your Land Conservation Series.....National Wildlife Federation	
Plants and Animals Live Together	All
Our World of Science.....Ginn and Co.	
Working with Science	69-77, 87-94 117-150, 267-303 305-334, 356-368
New Ideas in Science	99-118, 121-138 202-214
Going Forward with Science	7-33, 39-59 291-317
Science Plans for Tomorrow	123-159
Exploring Our World	300-353, 363-389
Our World Changes	193-303
Science in Modern Life Series.....Lippincott	
Exploring Science	26-63, 400-443
Enjoying Science	44-105

Science in Our Modern World Series.....Macmillan

Understanding Science	129-185, 347-393
Science for Daily Use	151-191, 375-411

Scientific Living Series.....L. W. Singer Co.

How and Why Experiments	5-21, 56-91 56-91, 96-115 122-133, 292-302 305-324, 341-356
How and Why Discoveries	5-34, 323-354

Unit Study Books.....American Education Press

Balance in Nature	All
Hibernation and Migration	All
How Plants Multiply	All

Wonderworld of Science Series.....Scribner's

Book Five	7-22, 181-202 213-241
Book Six	6-16, 195-231
Book Seven	103-117, 238-254 267-304, 129-152
Book Eight	129-152
Book Nine	84-111, 146-159 163-172, 194-205

B. Miscellaneous (Also refer to references listed under Units I and II.)

Author	*Title*	*Publisher*	*Pages*
*Cheyney-Hansen	This Is Our Land	Webb Pub. Co.	1-25, 212-215
Curtis	Conservation in America	Lyons & Carnahan	47-51, 99
Elliott	Learning to Conserve Natural Resources	Dept. of Pub. Inst., Lansing, Mich.	7-10 25-27
*Green	Partners with Nature	Inter. Textbook Co.	All
*Green	Right Under Your Feet!	Laurel Publishers	
McCullough	A Guide to Better Conservation for 4-H Boys and Girls (Second edition)	Federal Cartridge Corp., 2300 Foshay Tower, Minneapolis, Minn.	3, 8
Missouri Conservation Commission	Conservation Teachers Manual Vol. I	Missouri Conservation Comm.	14-15

* These can be secured from The I. S. E. A. Library Service.

Author	*Title*	*Publisher*	*Pages*
Renner & Hartley	Conservation & Citizenship	D. C. Heath	185-215
Selsam	Hidden Animals	International Publishers Co.	All
Zeasman	We Can All Help Save Our Soil	State of Wisconsin	4-5

Encyclopedias

Childcraft
Britannica Junior Encyclopedia
Compton's Pictured Encyclopedia
World Book Encyclopedia

Suggested topics from the Handbook of Science and Nature Study published by the Department of Public Instruction to be taught with the unit of Balance in Nature.

Topic	*Pages in Handbook of Science and Nature Study*
Controlling Flies and Mosquitoes	18
Insect Collection	19
Bulb Garden	21
Maintaining an Aquarium	22
Observation of Ant Colony	29
Collection of Plant Enemies	29-30
Rearing Insects	30-31
Getting Ready for Winter	34-36
Plants Insure Their Kind	38
Differences and Similarities Among Animals	44-48
Protecting Plants from Damage	89-90
Insect Pest Census	90-91

Unit IV — CONSERVATION OF MINERAL RESOURCES

Fall — 1950, 1953, 1956

I. TEACHER'S OBJECTIVES:

To help the pupils realize

A. That there is a close relationship between mineral resources and the wealth and prosperity of a nation.

B. That minerals are of no value as long as they remain buried, but they become valuable only when they are used intelligently.

C. That it has taken millions of years to make most of our mineral resources, and when once used they cannot be renewed (as can soil and forests)—they are gone forever.

D. That we should conserve our minerals. We should use care in extracting them and caution in using the products made from them, so they will last as long as possible.

II. PROCEDURE:

A. Approach and presentation of problem:

Teacher will read to pupils:

What is it that makes a nation wealthy and great? Is it because it has people superior to those of other nations? Is it because one nation has a better form of government than another? Why is it that even today if we were to travel over the world we would find people who have not changed their way of living from what it was thousands of years ago? Farmers plow or dig in the soil with a heavy hoe, or with oxen hitched to a wooden plow. They sow by hand, reap with a sickle, thresh with a flail, transport their produce on their backs, cook over an open fire, light their homes with candles, spin their own wool, weave their own cloth, tan their own leather, and make by hand what few clothes and shoes they wear. These were conditions that prevailed in America less than two hundred years ago.

Scientists who have studied races of people say that there is little difference among them in intelligence. The reason for the great progress of some of them, then, is revealed in this simple phrase, "*The preservation and use of natural resources.*" To be sure, the form of government may have a lot to do with the encouragement of the use of natural resources. It makes a lot of difference, too, where these resources are located, both as to how easily they can be obtained, and how near they are to each other.

Soil is, of course, our most important resource. You have already had some lessons on that and will have more later. You will want to know about some of our most important mineral resources which are found beneath the surface of the earth. You will be interested in learning how the use of these minerals has helped man to become civilized, and how the misuse of them will have serious consequence. You will want to know that our minerals, when used up, are gone forever. That is why we call them "nonrenewable resources."

The location of mineral resources is very important. Iron mines are much more valuable if they are near coal mines. That means cheap fuel may be obtained to fire the furnaces used in processing iron ore and to fuel the locomotives used in transporting the coal, pig iron, and steel.

We are going to learn something about some of our most important mineral resources. Let's take three of the most common ones,—oil, iron, and coal,—and see what we can find out about them.

Part I — Our Oil Resources

I. OBJECTIVES:

A. To help pupils realize the extreme dependence of our machine civilization upon oil.

B. To make pupils aware of the exhaustibility of our petroleum resources. To help them understand that the formation of our oil deposits required many centuries and once they are exhausted they are nonrenewable.

C. To show how we in the United States have wasted our oil resources through wasteful methods in the oil fields, wasteful consumption, and especially through *wars.*

D. To help pupils understand the ways in which we can conserve our oil resources through government action, more careful consumption, and in use of substitutes.

E. To help pupils learn the location of our present oil deposits and the possibility of opening new oil deposits, including those under the ocean on our continental shelf.

F. To help pupils understand how competition of nations for oil and other minerals is one of the basic causes of war and how this international competition will increase as old oil deposits are exhausted.

II. PROCEDURE:

A. Approach by teacher to pupils:

Oil in the form of gasoline for motor transports and airplanes, and fuel oil used in diesel engines for trains and ships has helped transportation make tremendous progress. One of the reasons our country ranks supreme in transportation is because we have far outstripped the rest of the world in oil production. But will this supply of oil continue indefinitely? The answer is, "No, it won't." Mineral resources are different from soil and forests because soil and forests can be renewed. Minerals cannot, so we say that they are "non-renewable". You will find as you read that it has taken millions of years for the oil to form. Once mineral resources are exhausted they are gone *forever.*

We call the period in which we are now living the "machine age." We ride in automobiles, trucks, trains, airplanes, and ships. We transport goods by these same means. We manufacture goods in factories where we use thousands of different machines. We have tractors, combines, and corn pickers to use in raising and harvesting crops. In homes we wash and iron clothes, clean rugs, sew dresses, and mix dough by machinery. Yes, we are living in a truly wonderful age—the Age of Machinery!

Did you ever stop to think, boys and girls, that if it were not for one product all this machinery would be useless? What is that product? (Petroleum.) Yes, we depend upon petroleum for the gasoline or fuel oil for power, and for the lubricating oil which makes our machines run smoothly, and prevents them from wearing out. If, by some great stroke of magic, all the world's oil were destroyed, our modern ways of living and working would no longer be possible. Imagine what your life would be like then.

We have just lived through the most destructive war of the world's history. Do you boys and girls understand that competition for oil among

nations was one of the causes of that conflict? During the time that the nations were fighting, they were using, burning up, and bombing out enough oil to last the entire world for many years of peace time use. Would you say, then, that we should try to avoid wars, and conserve our oil resources?

Where does oil come from? (Underneath the earth.) Do you know how it was formed? (Let pupils tell what they know, or make guesses.) You will find this out as you read. Let us remember that the formation of this oil took hundreds and thousands of years, and that when our present supply of oil is gone, there *will not be any more!* Is there anything we can do about this? (Let pupils comment.)

Let us begin by listing all the present day uses of oil which you already know. (List these on blackboard.) There are probably others you will find as you read to add to this list.

B. Topics for study and discussion:

1. Discuss any new uses for oil that you have found since you began your reading on this topic.
2. Read to learn about the formation of oil, its early uses, and the part it has played in the development of our civilization.

C. Suggestions for pupils' other activities:

1. Study pictures given in your references. Notice especially the inside front cover of "The Earth a Great Storehouse," the pictures in "The Story Book of Oil," and pictures in Compton's and World Book Encyclopedia.
2. Learn what you can about the location of the municipal oil fields in the U. S. and in other countries. Use products maps in geography books and other references. Upper grade pupils should make a map of their own.
3. Study the methods of drilling for oil and refining oil.
   a. What is meant by the terms "shooting a well," "gusher," "refinery"?
   b. In what ways are our methods of drilling and refining oil wasteful? How can this waste be avoided? Read page 90 in "Conservation of Natural Resources."
4. Study the methods of transporting oil.
   a. Tank cars, tank trucks, tank ships (tankers), pipe lines. Locate the principal pipe lines of the U. S. and of the world on a map.
5. Study further the uses of petroleum and petroleum products, placing special emphasis upon the ways in which this valuable resource is wasted.
6. What can be done by individuals and companies to conserve our oil?
   a. Eliminate waste in drilling and refining
   b. Eliminate waste in use of oil and its by-products
   c. Develop the use of substitutes, wherever practical, such as:
      (1) Alcohol made from potatoes, corn, and other farm products and waste materials in place of gasoline.
      (2) What are the possibilities of atomic energy being used as a substitute for oil in supplying power and heat?
      (3) What are the possibilities of using the sun's rays for fuel to save oil and coal?

(4) What are the possibilities of using other sources of heat to save oil and coal? (For instance, experiments are being carried on to determine if it is possible to heat our homes by heat extracted from the earth itself. In this experiment the heat is taken from the water in a deep well by means of refrigerator coils, the same way in which the heat is pumped out of an electric refrigerator.)

(5) Possibility of use of electricity generated by water power as a substitute for oil.

Be sure to emphasize that many substitutes would be more expensive than oil.

Read especially pages 92 and 93 in "Conservation of Natural Resources."

7. What can be done by our State and Federal Governments to conserve our oil?

Part II — Our Coal Resources

I. TEACHER'S OBJECTIVES:

To help pupils understand that:

A. We depend upon coal for power for factories, railroads, electrical plants, smelting of metals, and heat for homes.

B. Our coal resources are exhaustible. Once exhausted they can not be renewed.

C. It is important to know about our present coal deposits and the possibility of opening new ones.

D. As good coal deposits are exhausted, people will become dependent on sources of inferior quality and those more difficult to obtain.

E. United States has wasted its coal supplies through wasteful methods of mining and use.

F. There are ways of conserving coal through more careful mining methods, less waste in using coal, and in the use of coal substitutes.

II. PROCEDURE:

A. Approach and presentation of problem:

Teacher will read this to pupils:

We have already studied about our dependence upon oil in the machine age. Much that we learned about oil is also true of coal. The deposits of coal under the earth's surface are so vast that they seem almost unlimited. Scientists tell us that there is no danger of our coal supplies being exhausted within our lifetime, but coal, like oil, required many years for its formation, and once it is gone, there will be no more for thousands, perhaps millions of years. Since there is so much coal underneath the surface, our people have, in the past, recklessly wasted it by careless methods of mining and consumption.

If there is enough coal to last in our lifetime, why should we study about its conservation? (Let pupils discuss this question. Try to bring out the following thoughts in the discussion:)

1. While there is still plenty of coal in the ground, that which is *easily accessible is* rapidly becoming exhausted. As this happens, coal will become much more expensive, and higher prices of coal will cause higher prices of many of the goods and services upon which we depend such as: railroad transportation, heat for our homes, and manufactured products, especially those made from iron and steel.
2. We are interested in seeing our nation and our civilization continue to be great after we are gone. Our civilization cannot continue long if our coal resources are exhausted. We owe future generations an obligation which we should fulfill by *using wisely* the coal supplies which are at our disposal.

In order to learn what these ways of wise use are we shall consider these topics for study and discussion:

B. Topics for study and discussion:

1. Study and discuss methods of conserving our coal deposits, including the following:
   a. Methods of avoiding waste in mining
   b. Methods of avoiding waste in consumption
   (Bring out what can be done by the pupils themselves and their families to avoid waste of coal through such methods as improvement of furnaces and stoves, proper regulation of drafts, insulation and weather stripping of houses, and careful use of electricity, especially where it is generated by coal-burning dynamos. For instance, what was the reason for the "Brown Outs" during the war and during coal strikes?)
   c. How coal can be conserved by the use of substitutes. (See this same topic in Part I on oil, as many of the substitutes for oil are also substitutes for coal.) Emphasize particularly that using oil as a substitute for coal is *not a permanent* solution because oil is just as exhaustible as coal and is probably even more scarce.

C. Suggestions for pupils' other activities:

1. Make a list of all of the uses of coal which you know or can find by reading your references. (Do not overlook the many by-products of coal such as coke, tar, nylon, etc.)
2. Give oral reports about the formation of coal.
3. Study methods of mining coal.
   a. Draw a diagram of a coal mine. If possible visit a model mine.
   b. If any pupils have ever been in a coal mine have them tell their experiences. If none has seen a mine, let one or two of the pupils prepare talks or write a story about an imaginary trip through a coal mine. Invite someone who has visited a mine to talk to pupils.
   c. Notice especially how wasteful many mining methods have been. (For example, the ugly piles of soil at strip mines.) Discuss reasons for this waste and ways to avoid such waste in the future. What effect does present strip mining methods have on farms of that area?
4. Learn the different kinds of coal (anthracite, bituminous, and lignite) and tell the difference between them and the most common uses of each.

Part III — Our Iron Resources

I. TEACHER'S OBJECTIVES:

A. To teach the pupils the significance of the term "The Iron Age."

B. To show the importance of iron in our period of industrial development.

C. To acquaint the pupils with some of the methods used in mining and processing iron ore and with the products made from iron.

II. PROCEDURE:

A. Approach and presentation of problem:

Iron has been used by people in many parts of the world for centuries. There is a piece of iron in the British museum which is thought to have been made 6000 years ago. Historians say that civilization began when man first learned how to get and to use iron. One of the first known uses for iron was weapons—for hunting and in warfare. The most powerful armies in the ancient world were those which first learned to fashion weapons from iron.

One of the first important uses of iron to benefit mankind was the making of tools. (Hand tools and machine tools.) With good tools it is possible to make countless numbers of things in factories as well as by hand.

Most of the iron used in the world today is in the form of steel. Steel is iron that has been purified by heating in a very hot fire and mixing it with other metals. There are many different kinds of steel—at least 30 kinds in an automobile.

You will find as you read about iron that it is indispensable in a civilized nation. We use iron products in hundreds of different ways every day without giving much thought as to where it comes from, how long we can continue to produce it, or how we can best use it and conserve it. You will realize as you read that iron, like our other natural resources, is in danger of being used up—that it is a non-renewable resource. The following questions will be of help to you in looking up information about iron and steel.

B. Topics for study and discussion:

1. In what form is iron found in the ground?
2. Locate on a map the principal source of iron in the United States. (Northern Minnesota)
3. Explain types of iron mining. Find pictures to show these.
4. Explain how iron ore is processed into iron.
5. Explain how steel is made from iron.
6. Explain cast iron and pig iron.
7. How does our reserve supply of iron ore compare with reserves of oil and coal?

C. Suggestions for pupils' other activities:

1. Write to the Oliver Mining Co., Hibbing, Minn., for samples of iron ore and free literature about iron mines.
2. List ten important products made from iron or steel.
3. Make a collection of different kinds of iron and steel products.
4. Make a scrapbook dealing with pictures and information about iron and steel.

D. Culmination of unit:

Give a program before adults or another grade at which time pupils share with their audience some of the interesting information they have acquired. Let them show and explain about their collection, their scrapbooks, their diagrams of mining operations, etc. A film strip or teaching film could be shown as a final activity.

Conservation of Minerals

III. REFERENCES:

A. Science Textbook Series:

	Page
GRADES 1-4 inclusive	
Our World of Science Series.....Ginn and Co.	
Exploring in Science	245-260
GRADES 5-8	
Basic Science Education Series.....Row, Peterson and Co.	
The Earth a Great Storehouse	All
America's Minerals	All
America's Oils	All
Nature Science Books.....Albert Whitman and Co.	
The Story of Coal	All
Oil and Gas	All
Iron and Steel	All
Our World of Science Series.....Ginn and Co.	
Going Forward with Science	91-121
Science in Modern Life Series.....J. B. Lippincott Co.	
Exploring Science	208-213
Science in Our Modern World Series.....Macmillan	
Science for Daily Use	60-62
Scientific Living Series.....L. W. Singer	
How and Why Explorations	258-272
How and Why Conclusions	18-45, 298-300
Unit Study Books.....American Education Press	
Petroleum	All
Wonderworld of Science Series.....Scribner's	
Book Five	71-77
	239-240
Book Eight	111-123

B. Miscellaneous references:

Author	*Title*	*Publisher*	*Pages*
*Petersham	The Story of Coal	John C. Winston Co.	All
*Petersham	The Story of Oil	John C. Winston Co.	All
Renner and Hartley	Conservation and Citizenship	D. C. Heath & Co.	228-230
Renner and Hartley	Conservation of Natural Resources	Ginn & Company	84-97
Britannica Junior Encyclopedia			
Compton's Pictured Encyclopedia			
World Book Encyclopedia			

* Can be obtained from The I. S. E. A. Library Service, Shops Bldg., Des Moines, Iowa.

Suggested topics from the Handbook of Science and Nature Study published by the Department of Public Instruction to be taught with the unit on Conservation of Mineral Resources.

Topic	*Handbook page*
Rock and Mineral Collection	67

Unit V — CONSERVATION OF FORESTS AND TIMBERLANDS

Winter — 1950, 1953, 1956

I. TEACHER'S OBJECTIVES:

A. To instill in pupils a sincere interest in our timber resources and a desire to help in the conservation of them.

B. To learn how we are dependent on trees for: shelter, food, fuel, tree products, and protection for ourselves and animals.

C. To learn how trees help to conserve soil and to prevent floods.

D. To learn forest management practices and the agencies which help to preserve our forests.

II. PROCEDURE:

A. Approach and presentation of problem:

Teacher read to pupils:

A certain poet wrote some lines that give us ideas about trees that you may never have thought about before. The tree speaks to the traveler and it says:

TO THE WAYFARER

Ye who pass by and would raise your hand against me, harken ere you harm me. I am the heat of your hearth on cold winter nights, the friendly shade screening you from the summer sun, and my fruits are refreshing draughts quenching your thirst as you journey on. I am the beam that holds your house, the board of your table, the bed on which you lie, and the timber that builds your boat. I am the handle of your hoe, the door of your homestead, the wood of your cradle, and the shell of your coffin. I am the bread of kindness and the flower of beauty. Ye who pass by, listen to my prayer. *

Another poet says much the same thing:

Many a tree is found in the wood,
And every tree for its use is good;
Some for the strength of the gnarled root,
Some for the sweetness of flower or fruit;
Some for shelter against the storm,
And some to keep the hearthstone warm.
Some for the roof and some for the beam,
And some for a boat to breast the stream;
In the wealth of the wood since the world began
The trees have offered their gifts to man. †

—Henry Van Dyke

I wonder if we have thought as much as we should about these "gifts to man"? You have learned how much the pioneers depended on trees when they settled our country. Life would have been very hard for them without trees. You have read how men cut trees to make trails westward. They cut trees down to build homes, boats, rafts, and wagons. They

* Author unknown. Reprinted from a bulletin by the Michigan State Department of Education.

† From SALUTE TO THE TREES by Henry Van Dyke, by special permission of Charles Scribner's Sons, Publishers, New York.

were grateful to trees for shade in hot weather and for shelter against wintry winds. Perhaps these pioneers felt there were so many trees that they would last forever. And yet, today, we are hearing about shortages on every hand—of paper (that comes from forests), of wood for buildings, etc. And we are all talking conservation. If we are to understand why we need to conserve forests and how they serve us, we need to know some things about forests at the beginning of our country's history.

Our forests are considered one of our most valuable resources. They have played a major part in the development of the country, and the history of the United States is staged against a forest background. From the time the earliest settlers reached our New England coast, the forests have had an important part in the life of the country. They furnished the early settlers timber needed for building and furnishing of their new homes, and provided them with protection and food. The first colonial industries were forest industries, and some of the first products shipped back to England and European countries were forest products such as lumber, barrel staves, pitch, tar, and long timbers for ship masts.

As our country grew, the forests continued to play an important part in this growth. Prairie schooners (covered wagons) and canal boats were made of wood. The early railroads, like those of today, were laid on wooden ties. In fact, forests were so important in the growth of our country that whenever new settlers moved into an area it was always in wooded sections such as in valleys and along streams that they settled.

Even today we still depend upon our forests to furnish us with many of the items which are necessary in our everyday life. How many articles in the classroom can you name which come from our timberlands? (Desks, bookcases, floor, window frames, pencils, plastic pens, books and paper, rayon clothing, pictures and frames.)

How many items can you name which you use at home during the day which come from our timberlands? (Beds, tables, chairs, plastic telephones, telephone and telegraph poles which carry the wires, plastic steering wheel, horn button, etc., on their car, rayon clothing, felt hats, newspaper, toys, and others.) There are many other things that you will find as you read.

Many different kinds of wild animals need the forests as the forests furnish them with food, water, protection and homes. Such animals as deer, elk, moose, bear, wildcats, raccoon, squirrels and others are found only in or near timbered areas. And many of our most beautiful and valuable birds need trees, as the trees furnish them places in which to build their nests, and fruits and berries of different kinds as food. The clear, cool streams in forested areas are necessary for many different kinds of fish, and it is only in such streams that we find the beautiful trout.

Forests help to provide recreation. People like to go to a timbered area for their vacation, for it is there that they will find beautiful scenery, wild animals and birds, beautiful flowers, clear streams and lakes, and interesting trails.

We cannot continue to enjoy all the benefits of forests if the forests are lost to us through cutting and fires.

Perhaps, we too, like the pioneers, have taken trees for granted, not realizing that our lives might be much more difficult and more uncomfortable if we had no trees. Let us refer again to the second poem. You notice that the poet mentions a tree is good for "sweetness of flower." Which trees do you think of? (List replies) For the "sweetness of fruit"? Which ones for shelter? How do they "keep the hearthstone warm"? The poet says trees are useful "for the strength of the gnarled

root." What does he mean? (Tell or show meaning of "gnarled" and lead pupils to tell how gnarled roots help to hold the soil.) So the poet really tells us that trees are conservationists as they help to conserve soil.

Our lives are affected in many ways when our trees disappear. Some of these ways you will learn as you read about forests and timberlands. When we talk of trees in general we must consider Iowa's own woodlands—those covered with trees which have sprung up by seeds taking root by themselves. Part of this woodland, about 22,000 acres, is in State Parks or set aside for a particular use. Over two million acres in the state are available for growing forest products. By that term we mean sawn lumber and railroad ties, logs for veneer, fuel wood, fence posts and poles, and timbers and ties for mines. In 1946 the harvested values of these products was over seventeen million dollars.

Experts in forestry claim that if our woodlands were put under better management than they now have, these woodlands could be made to produce three times as much as they now do. They tell us the big problem is to improve and increase the amount of woodlands. As you read you will see how this can be done.

Another important use of trees which we shall discuss is that of windbreaks. Trees planted for windbreaks will help protect farm buildings and farm animals from severe winter weather. They will also provide cooling shade in hot weather. We can realize how important windbreaks are when we realize that they will help to reduce the cost of heating our buildings, and will reduce the amount of feed necessary to produce a pound of meat or a quart of milk. We shall study more about windbreaks as we read about woodlands.

B. Topics for study and discussion:

1. What has happened to the forests which pioneers found here?
2. Why is it so necessary to conserve our forests today?
3. Where are the important forest areas in the United States?
4. What kind of trees are found there? What products come from them?
5. What do forests do for people? For animals?
6. What profit can be made from harvesting timber crops?
7. Why is black walnut such a favorite?
8. What is the relation between paper shortage and the destruction of forests?
9. How are forests used by: scientist, hunter, naturalist, photographer, camper, farmer, and furrier?
10. How do trees save soil?
11. How do trees help build soil?
12. How do trees prevent floods? (Three ways)
13. What happens when hillsides near streams are not forested?
14. What wastes and misuses cause forest destruction? How can these practices be prevented?
15. What does this waste cost each year?
16. How many acres in Iowa are in timberland and woodlots?
17. What are the ways in which over-grazing damages the lands? How can this be prevented?
18. What is meant by watersheds?
19. How are the watersheds related to dust bowls?
20. List suggestions for planting a timber crop. Where should this be planted? What kind of trees should be planted?
21. Many acres of land should be returned to timber production. Why?

22. In what ways do insects and diseases destroy trees? Tell how these can be controlled.
23. How may a forest be a source of enjoyment and recreation?
24. Do we have state forests in Iowa? If so, what is their value? When did they come into existence?
25. What have federal and state governments done to protect forest areas?
26. How do the forest rangers help conserve and protect our forests?
27. What helps to forest have the following been: airplanes, radios, parachute jumpers?
28. What have the 4-H clubs done to promote conservation of forests in our country?
29. What is meant by a "community forest"?
30. Learn how to improve woodland by cutting.
    a. Thinning of overcrowded stands
    b. Removal of defective or poor quality trees
    c. Removal of mature or full-grown trees
31. Learn how to determine causes of injury to trees by the following, and how to prevent these injuries:
    a. Fires
    b. Grazing
    c. Insects and disease
32. Study how the forest or woods conserve soil moisture, check soil erosion and modify temperature.
    a. How a forest conserves the water from a rainfall or heavy snow
    b. Flow of streams from open and forested lands; seepage and springs
    c. How do trees protect slopes against erosion and formation of gullies?
33. Discuss the following topics:
    a. What is meant by mining a forest?
    b. Is timber a crop?
    c. The tree is a living thing
    d. How a tree provides for baby trees to grow up
34. Find out the best way to plant a windbreak to protect your buildings. What trees will you plant, how wide a strip, how long, how far apart, on which side of buildings?
35. What ways have you learned that the yield of forest products can be increased?
36. Discuss the responsibility of the State Conservation Commission toward preservation of Iowa's timberlands.

C. Suggestions for other pupil activities:

1. Visit a roadside improvement project and make a plan for improving a roadside in your community.
2. Take a field trip to visit a black locust tree planting in your community. Write an account of the trip.
3. Make a map of your school district or farm showing where trees should be planted. Show what trees would be best to plant in each place.

4. Use pictures, posters, slides, or films showing logging and milling operations, fires, results of grazing, wildlife, and products we obtain from our timberland.
5. Take a field trip to study different kinds of trees and how different kinds of wildlife are using them.
6. If possible, take field trip to study an ungrazed woodlot and a grazed woodlot, and observe the absence of seedlings and small trees in the grazed area, which are necessary if the area is to continue as a permanent woodlot, as the small trees are necessary to replace the old trees after they are cut or have died.
7. If possible, visit a sawmill and observe the manufacture of lumber.
8. Make a collection of the seeds of at least ten of the most common trees in your locality. Study these and learn the various devices of nature for scattering the seed widely.
   a. Fruit with wings—wind
   b. Pulpy fruits with a berry for a seed—birds
   c. Rich nuts or kernels—squirrels
   d. Light seeds which will float—water
9. Study an ungrazed and unburned timbered area to see reproduction taking place in the form of small seedlings, small saplings, large saplings, and young, thrifty trees.
10. Learn how to recognize the more common trees found in your locality.
    a. Leaves, buds, fruit or seeds, bark, and general appearance of the trees.
    b. Make a leaf collection of at least ten of the more common trees in the area. Learn to recognize these on sight. If the fruit or seed is present, gather this also.
11. Plan a bulletin board illustrating some phase of forest preservation or rebuilding.
12. Make a collection of pictures of our tree and forest wonderlands.
13. Make a collection of tree poems.
14. Make a scrapbook showing current items and pictures pertaining to our forests.
15. Make a list of animals that make homes in trees.
16. Plan an Arbor Day program for your school and plant young trees where they are needed. (See insert from "Iowa Conservationist," January 15, 1947 issue—page 99.)
17. Make 2 maps of the United States—one showing forests at the time the white people came to America and one showing forest areas at the present time.
18. Make a poster illustrating one of the following:
    a. Fire Prevention
    b. Protection of Wild Life
19. Collect and mount specimens of hard and soft woods found in your locality.
20. Locate on a map the state forest and state parks used as recreational areas.
21. Make a survey of the kinds of woodland in your community.
22. Make a map of your school district showing a sketch of its woodlands.
23. Make a set of rules for campers and picnickers that would help protect forests.

24. Give a report to the class on the Christmas Tree industry.
25. Make a large chart showing the gifts of the forest.
26. Perform one act of conservation—write up what you did and the reason for doing it.

D. Culmination of Unit:

Assemble all the reading materials, art work, scrapbooks, charts, picture collections, etc., and invite parents or children from another grade to "Open House." Each display, chart, collection, etc., should have a pupil standing by to explain it to visitors. A program of poems and/or songs about trees to follow the showing of exhibits would be very appropriate. Such a program could be given to observe Arbor Day when trees and shrubs are planted on the school grounds.

Topics in the Handbook of Science and Nature Study which are suggested to be taught in the same term as the unit on Conservation of Forests and Timberlands.

Topic	*Handbook pages*
Tree Exhibit	70-71
Beautifying Schoolgrounds	81
Tree Planting	82
Use of Public Parks	82-83
Leaf Collection	16-17
Leaf Prints	17-18
Nature Trail	81
Nature Map	25
Using Plant Saps	33-34

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With Judy and Joe	66-67
With Bob and Don	39-45, 94-96
With Jane and Paul	79-82, 101-117
With Doris and Billy	162-168, 171-188
With Jack and Jill	53-56, 231-253
Curriculum Foundation Series.....Scott, Foresman and Co.	
Look and Learn	48-51, 55-56 62-64
All Around Us	11, 18, 26, 27 65, 67
How Do We Know?	7, 15, 21, 30-35 39, 66-69
Discovering Our World, Book I	38-43, 200-201 204-207
Nature Science Books.....Albert Whitman and Co.	
From Seed to Tree	All

Our World of Science Series.....Ginn and Co.
Science All About Us 72-75
Science Every Day 112-114, 236-243
Exploring in Science 269-291

Scientific Living Series.....L. W. Singer Co.
Winter Comes and Goes 36-46, 81-83
144-145
The Seasons Pass 13-31
The How and Why Club 271-281

Wonderworld of Science.....Scribner's
Book One 89-90
Book Three 170-172

GRADES 5-8

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With Ruth and Jim 14-23, 47-48
301-319

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American Forest Products Industries, Inc.	Trees for Tomorrow	American Forest Products Industries, Inc. 1319 Eighteenth St., Washington 6, D. C.	
American Forest Products Industries, Inc.	American Forests	American Forest Products Industries, Inc. 1319 Eighteenth St., Washington 6, D. C.	
American Forest Products Industries, Inc.	Paul Bunyan's Quizz	American Forest Products Industries, Inc. 1319 Eighteenth St., Washington 6, D. C.	
*Caldwell et al.	Our Land and Our Living	Singer, 1941	30-60
*Cheyney & Hansen	This Is Our Land	Webb Pub. Co., 1940	808-814
Clark, Fitzpatrick Smith	Science on the March, Book II	Houghton Mifflin Co.	174-176
*Comstock	Handbook of Nature Study	Comstock Pub. Co.	618-692 808-814
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Louisiana Forestry Commission	Ten Lessons in Forestry (Free from Commission at Baton Rouge, La.)		
Mattoon	Forestry for 4-H Clubs (Miscellaneous Pub. 395)	U. S. Government Prtg. Office	

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Power, Kirlin	Practical Farming	E. M. Hale & Son, 1944	279-299 503 507-508
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Farmers Bulletin No. 1177

Arbor Day
No. 1526

Forestry for 4-H Clubs
No. 395

Forest Trees and Forest Regions of the U. S.
No. 217

How a Tree Grows

Our Forests: What They Are and What They Mean to Us
No. 162

Products of American Forests

Protect Hardwood Stands from Grazing
Leaflet No. 86

Taming Our Forests

The Work of the U. S. Forest Service
No. 290

What Forests Give

What We Get From Trees

Living and Forest Lands
No. 388

Unit VI — WATER CONSERVATION AND FLOOD CONTROL

Spring — 1951, 1954, 1957

I. OBJECTIVES:

A. To help the pupil realize and understand that water is an inexhaustible resource that must be wisely used and controlled.

B. To help the pupil realize and understand that water is essential to life.

C. To help the pupil realize and understand that too much water or too little water may cause destruction of life and property.

D. To help the pupil realize and understand that there is a need for the use of water control measures.

E. To help the pupil become familiar with practical water control measures.

II. PROCEDURE:

A. Approach to pupils (To be read to the pupils by the teacher):

Water is one of man's greatest friends and one of his greatest enemies. Water *gives* life and water *destroys* life. Without water to drink men and animals can live but a few days. Without water the plants that furnish food for man and animals shrivel and die causing hardship, starvation and death.

Yet when we have too much water great damage is done. We have already learned that water removes valuable soil nutrients which are needed as plant food and are very essential to human health. Water rushing down our hillsides carries valuable top soil, cuts gullies, destroys crops, bridges, and roads. The silt carried by water destroys our recreational facilities by killing fish and filling up our natural and artificial lakes. When the water from many hillsides and small streams comes together in the larger rivers, destructive floods occur, resulting in millions of dollars' worth of damage to farms, livestock, factories, businesses, and homes, and causing hunger, disease, and death.

We are about to begin the study of Water Conservation and Flood Control. In this study, we should bear in mind that water is not an exhaustible resource like coal, oil, or iron. There is no danger that the supply of water may become exhausted. Nature supplies water in abundance, but Nature does not always distribute water to suit the best interest of man. Some areas of the earth's surface are almost uninhabited because Nature provides little water for that area. Other areas are inhabited only by a few natives because Nature is too generous with her supply of water. Even in areas, such as Iowa, where the total supply of water is well suited to man, there are seasons when we have too much water and other seasons when we suffer because of too little water. Sometimes our farmers lose because of floods, drowned out crops, and fields that are too wet to plant. At other times their crops are damaged by drouth.

We have seen that man suffers when there is too little water and when there is too much. Often the damage done by water is caused by the fact that it flows *too fast* rather than because there is either too much or too little. We have already studied in our soil conservation units how man is rapidly learning to control the flow of water by the use of terraces, contour farming, strip cropping, grassed waterways, diversion ditches, gully

dams, reservoirs, restoration of pastures and forest lands, proper crop rotations, and other soil and water conservation methods.

Man's effort to live has always involved a struggle to control the forces of Nature and harness them for his own good. A great deal of man's fight to live has been directed toward the control of water. As we study this unit we shall see how man has learned to practice irrigation where Nature has been ungenerous with water, and to remove surplus water by drainage where Nature is too generous with her supply of water. We shall also find out how man is attempting to work out plans to store surplus water during rainy seasons and to release it for irrigation and power during dry seasons. We shall study methods of flood control and review the methods of soil conservation which are also connected with water conservation and flood control.

B. Presentation of Problem and Questions for Study:

In order that you boys and girls may better understand the problem of water conservation, let us begin our study by making a list in one column of all the ways in which water is useful to man, and, in another column, all the ways in which water may be harmful to man. (Probably the following will be listed by the pupils. If not, teachers may solicit these responses by skillful questioning.)

Usefulness of Water	*Harmfulness of Water*
1. Drinking—giving life to human body.	1. Floods cause loss of life and property.
2. Cleanliness — washing bodies, clothing, homes, streets, sewage disposal, etc.	2. Causes good soil to be washed away.
3. Transportation — lakes, rivers, oceans, canals.	3. Too much or too little rain often cause crop failures.
4. Water power— a. direct turning of machinery. b. generate electricity.	4. People drown in water when swimming or boating.
5. Helps plants to grow (thus makes our food possible).	5. Washouts—bridges, roads, railroads, etc.
6. Swimming, boating, fishing, skating, and other recreation.	6. Cause land slides.
7. Has effect on climate— a. prevents extremes of temperature.	
8. Irrigates dry lands.	
9. Provides food—(fish and other products).	
10. Provides means of livelihood—fishing, whaling, oyster farming, pearl fishing, etc.	

As we study the problem of water conservation during the next few weeks, we should try to find answers to the following questions:

1. Where does water come from? What is meant by the water cycle? (See pages 32-33 of Conservation of Natural Resources.)
2. What are the different forms of water? (Liquid, hail, dew, sleet, snow, rain, ice, fog, mist, frost.) Look up each of these terms in the dictionary, encyclopedia, or other references and be able to tell the difference.
3. How is water used by the human body?
   a. What percent of body is water?
   b. How much water should we drink each day?
   c. How is the body temperature regulated by perspiration?
4. Why is pure water essential?
   a. What diseases may result from drinking impure water?
5. How can we secure pure water?
   a. In rural schools and on farms?
   b. In towns and cities? Study how some large cities secure their supplies of pure water.
6. How do plants and animals depend upon water?
7. What are some of the harmful results of too much water?
   a. Floods
   b. Crop failures
8. How may floods be prevented and controlled?
9. How may wet lands be drained to make them more useful to man?
10. What can be done through irrigation to make dry lands more useful to man? Be able to describe methods of irrigating.
11. How may we prevent damage by slowing down the flow of water?
12. How are the problems of soil conservation and water conservation closely connected:
    a. How do terracing, contour farming, gully control, strip cropping, restoration of pastures, reforestation, and other soil saving practices help to conserve moisture and prevent floods?
13. How can we provide greater recreational facilities through the practice of water conservation?
    a. Artificial lakes for swimming, boating, fishing.
    b. Farm ponds.
    c. Desilting of streams and lakes by slowing down water run-off.
14. What is being done by individuals, government and other agencies to solve the problem of water conservation?
15. Why is the proper use and control of water important to each of us? That is, what loss will be suffered by each of us and by our communities, state, and nation if we fail to use proper methods for the control and use of water?

C. Suggestions for pupil activities:

1. Trace a raindrop until it comes back to earth. Show by diagram the water cycle.
2. Make a map showing where water flows leaving your community. Locate the large rivers, arms of the ocean, states, large cities.

3. Make a list of all the streams and ponds in your community. Are they healthful? How can you tell?
4. Collect a sample of water from a stream before a rain and after the rain. Give description of the appearance of both. What causes the difference?
   a. Illustrate by a drawing the "water table."
   b. Make a list of minerals found in water.
   c. Make a list of the differences in fresh water and salt water.
5. Select pictures to illustrate different kinds of dams, floods, recreational uses of water. Place on bulletin boards.
6. What foods are found in the water?
7. Report on the T.V.A. project. Name and locate other projects carried on by the government.
8. Make a list of damages done by floods.
9. Make a rainfall map of U. S. Locate the Federal Government irrigation projects.
10. Collect clippings about floods. In what season of the year do they most likely occur?
11. On a map of the U. S. draw the longest river and its tributaries.
12. Explain what is meant by an artesian well, spring, drilled well, dug well. How do they differ in depth?
13. Make an excursion to a town to see how water is kept pure.
14. Make an excursion to stream to clear away leaves and dirt from beds of spring and streams.
15. Keep a rainfall record for the school year.
16. Compare number of pails of water used daily in a country home with that of an urban home.
17. See how long it takes for a pint of water to evaporate from a cloth hung in the sun, and in the wind.
18. Read to see how Los Angeles gets its water supply.
19. Make a map of your county showing main watersheds, locate
    a. largest streams
    b. rich lands
    c. best crop
    d. places of food
    e. greatest places of erosion
20. Make a list of Governmental agencies, State Agencies, local groups and individuals who are working on this problem of water conservation. List what each agency or group is doing in this regard.
21. Prove that moisture is given off by green plants by covering a plant with a glass jar and watching results.
22. Find out where electricity comes from in your community.
23. Report on the Little Sioux Flood Control Project in Iowa. How will this affect your community?
24. Locate a water conservation problem in your school yard; determine what should be done and correct this problem.
25. Take field trips and locate water conservation problems in the neighborhood.
    a. List practices that are being applied to help correct these problems.
    b. List additional practices that should be used to correct problems further.
26. Water Conservation

New words and terms to learn:

water cycle	pollution
water supply	surface water
water shed	drainage
water table	surface drainage
levee	tile drains
dike	up stream control
dam	down stream control
aqueducts	retarding basin
spillway	river channel
irrigation	artesian well
delta	spring
reservoirs	dug well
flood stage	drilled well

D. Culmination of unit:

Review important learnings of this unit. Help pupils to make a series of summarizing statements that will include the following ideas:

1. We have learned that water is a very important resource that must be used wisely and managed well to be of most benefit to mankind.
2. We have learned that there are many harmful and damaging results of uncontrolled water. We have learned that every one must be concerned with these problems and that each individual must do his part in aiding water conservation.
3. We have learned that too much water as well as too little water causes serious problems. In some areas of our state and nation drainage practices must be developed to remove excess water from our land in order to raise good crops.

   Soil conservation practices and flood control measures are important in other areas. It may be necessary to establish soil conservation practices such as: Contouring, strip cropping, terraces, grass waterways on farm land in watersheds. It is also necessary to build some dams on the streams, and to construct levees and dikes along the major streams in order to save our soil and protect us from floods.
4. We have learned that proper water control and conservation measures will benefit agriculture, industry, and each one of us individually. Drainage and conservation practices applied on farm lands help keep our soil in place and silt out of our streams. They conserve moisture needed for growing of crops, and increase production of crops.

   Dams properly constructed in streams will aid in holding soil and water, will provide water power for developing electricity, and will provide impounded water for use in irrigating many acres of good farm land for crop production. Artificial lakes resulting from constructing these dams will also provide additional food and recreational facilities.

   Levees and dikes properly constructed along main stream channels will make it possible to use many thousands of additional acres of good river bottom farm land for crop production.
5. We have learned that public and private water supply systems must be safeguarded at all times by providing adequate sanitary facilities.

Unit VII — MAINTAINING SOIL FERTILITY

Fall — 1951, 1954, 1957

I. TEACHER'S OBJECTIVES:

A. To help pupils understand the relation of soil fertility to human health.

B. To cause the pupils to realize that soils differ greatly in fertility, that the fertility of poor soils can be greatly improved, and that fertile soils may become poor soils as result of cropping without the return of organic matter and mineral nutrients.

C. To impress upon the pupils that erosion may reduce fertility more quickly than heavy cropping.

D. To develop in pupils an interest in soil fertility improvement.

E. To teach some of the basic facts of science as related to soils.

F. To teach the principal factors of soil management.

II. PROCEDURES:

A. Approach and presentation of problem:

(The following information should be presented, preferably in the teacher's own words.)

During the past few years there has been a great deal written about soil fertility and human health. This is a subject in which everyone is interested because we all want to enjoy good health. The most important point about soil fertility and human health is that people who live on fertile soils generally have a higher standard of living than people who live on poor soils. It is easy to see that a family living on a worn-out or badly-eroded soil may have so little money that their children simply won't have a well-balanced diet. Some writers say that the health of our people is getting worse because our soils are wearing out. There is no proof that the health of the people of our nation is deteriorating only because of soil erosion or soil depletion. In some respects the health of this nation as a whole is improving. In this unit of study we shall try to understand how the state of our health is related to the fertility of the soil from which our food comes. Then, too, we shall learn how, when soil is lacking in fertility, it is possible to make it more productive. Here are some questions we shall discuss after you have read your references.

B. Questions for discussion and study:

(Much of the material presented in this unit may not be found in references available to pupils. Teachers should give pupils an opportunity to find the answers to the questions. If these are not possible to find, then the teacher may give pupils the information presented in this unit. Review the topics occasionally to make the facts meaningful.)

1. Are there diseases of man which are caused by something lacking in the diet?
   (a) The disease known as Beriberi is caused by a lack of vitamin B1. This disease was most widespread in the Orient

where people lived almost altogether on polished rice. This disease was traced to the removal of the husk from the rice grains rather than to the lack of vitamin B1 in the plant. In other words, Beriberi is not due to poor soil but to the method of processing the rice.

(b) Goiter is caused by a lack of iodine in the diet. There are regions where iodine is not found in the soil or drinking water and it is necessary for people to eat foods known to contain iodine. People use salt which is treated with iodine to balance the diet. This lack of iodine is not due to soil erosion or soil depletion.

(c) Rickets is caused by a lack of calcium in the diet and may be caused by a lack of vitamin D. Children who have plenty of milk to drink and who get plenty of sunshine do not develop rickets.

(d) Tooth decay is worse in some areas than in others. Children in Hereford County, Texas, have very little tooth decay. This is due to the flourine in the water which these children drink. The lack of flourine in the diet causes teeth to form which decay easily, but too much flourine causes abnormally developed teeth. Again, tooth decay is not a result of soil depletion or soil erosion.

2. How much of a family's money allotted for food is spent for dairy products?

About one third of the money spent for food in this country is now spent for milk, butter, cheese, cream, and ice cream.

3. List the more common foods in two columns with headings "animal products" and "plant products."

Animal Products	*Plant Products*
Milk	Beans
Butter	Potatoes
Cream	Carrots
Ice Cream	Wheat Flour
Eggs	Corn Meal
Pork	Oat Meal
Beef	Peas
Mutton	Cabbage
Fish	Lettuce
Etc.	Fruits
	Etc.

4. If a family is very poor, which groups of foods will be used mostly?

The plant products will be used to the greatest extent because they are the cheapest source of energy.

5. If a family has plenty of money for food, or can raise all the food at home, which group of foods will make up the greater part of the diet?

(a) The animal products will be used in greater amounts. They are more expensive, but they are also a better source of proteins, minerals, and vitamins as well as being a good source of energy. A well-balanced diet containing milk, meat, butter, eggs, fruits, and vegetables is necessary for man to enjoy good health.

(b) In a notable report by McCarrison, dealing with foods of natives of India, people of North India living on a diet of whole wheat, milk, legumes, vegetables and some meat were described as a "stalwart resolute race"; those in South India living on a diet containing a large proportion of polished rice, some legumes, fruits and vegetables, but little or no milk or meat, were described as "boneless, supine (unactive; indolent) and poorly developed."

(c) The British Medical Research Council reported on the physical structure and health of two tribes in Kenyu, Africa. One tribe ate mostly milk and meat. The other tribe ate mostly cereals, roots, and fruits. In the first tribe mentioned the male was 5 inches taller and 23 pounds heavier than the average male of the other tribe. In addition the average male of the first tribe had 50 percent greater strength.

6. Is it possible for a poor soil to cause a poor diet for the people who raise all their food at home?

(a) If the family were to restrict their diet to plants grown on poor soil, then poor health is likely to result. Plants may vary greatly in their food value because of differences in soil fertility. Even plants that look alike may vary greatly in their food value.

(b) If the family who lives on poor soil eats a great deal of animal products they may be just as healthy as people living on rich soil. A cow feeding on grass grown on poor soil may not produce much milk, but a glass of her milk may be as high in food value as a glass of milk from a cow fed on good pasture.

7. Is the problem of human nutrition and animal nutrition different insofar as soil fertility is concerned?

(a) People get their food from many locations. They also use a large proportion of animal products which are known to be high in food value.

(b) Farm animals may eat only the feeds that are grown on the farm. Furthermore, the feed of farm animals may be limited entirely to plant products. It is well known that plants vary greatly in their food value because soils vary in fertility. If the soil on the farm is low in calcium or phosphorus then the plants grown on the soil will also be low in these elements. Phosphorus may be so low in some soils that animals eating plants grown on the poor soil may become so starved for phosphorus that they may be seen to chew on bones. There are many areas in the United States where the phosphorus content of the soils, and the phosphorus content of the plants grown on the soils, may be so low that a mineral supplement must be fed to the livestock. The famous King Ranch in Texas is located on soils very low in phosphorus. For several years, the managers fed the cattle additional phosphorus by including phosphate in the drinking water. Recently, the managers have found it best to put the phosphate on the soil. By putting the phosphate on the soil, they found that more grass was produced than before. Also the grass contained enough phosphorus for the animals.

There are many other elements besides calcium and phosphorus which may be lacking in plants. Some other elements which have been found to be lacking in feeds are cobalt, iodine, copper, and iron.

8. List the elements known to be essential to plant life. Name the source.

Element	*Source*
Carbon	In carbon dioxide of the air.
Hydrogen	Water.
Oxygen	Water and air.

The three above elements come from the air and water. They make up about 95 percent of the dry weight of plants. They go up in smoke when we burn plants. The chlorophyl in the green leaves enables the plant to transform the energy from the sun along with carbon, hydrogen, and oxygen into sugars. The sugars are used in making up the more complex compounds in the plant structure.

Element	*Source*
Nitrogen	Air, organic matter.
Phosphorus	Soil minerals and organic matter.
Potassium	Soil minerals.

The above three elements are called the fertilizer elements. When a farmer buys a sack of "complete" fertilizer he buys nitrogen, phosphorus, and potassium.

Element	*Source*
Calcium	Soil minerals
Magnesium	Soil minerals

The above two elements are called the lime elements. When a farmer buys limestone he is getting mostly calcium carbonate with some magnesium carbonate.

Element	*Source*
Iron	Soil minerals
Sulfur	Soil minerals and organic matter
Manganese	Soil minerals
Copper	Soil minerals
Boron	Soil minerals
Zinc	Soil minerals
Molybdenum	Soil minerals

The last seven elements are known as trace elements since only a very small amount of each is used by plants.

9. Is the supply of the 15 essential elements permanent?

Any one of the 15 essential elements obtained from the soil may become lacking in the soil. Some soils were low in certain of the essential elements as result of crop removal, grazing, leaching, and erosion.

10. Can we make soils more productive than our forefathers found them?

Many of the soils of the eastern states are more productive today than they were when white man came to this country. The soils were originally under a forest cover and the soils had been badly leached through centuries of high rainfall. Soil scientists have learned how to build up the supply of essential elements in these soils to where they are now much more productive than they were when first brought under cultivation.

11. The prairie soils of Iowa are known all over the world for their high fertility. Are our soils as fertile today as they were when they were first put into cultivation?

(a) There are many farms in Iowa which are just as fertile as they were the year they were first cultivated. But most of the soils in Iowa have been badly abused. Soils on sloping lands have been eroded when planted to corn and soybeans. Most farmers prefer to plant their corn up and down hill so they can have check-rows. They know that it is easier to control weeds if they use the check-row system of planting. Soybeans leave the soil loose and, even though the rows are on the contour, erosion is very severe on soybean ground if the land is sloping and is not terraced. Besides erosion, the soils of Iowa have been cropped heavily, without much use of commercial fertilizers. It is only recently that farmers have started using very much commercial fertilizer in Iowa.

(b) In 1948, the average yield of corn for the state of Iowa was 61 bushels per acre. This yield was an all-time high record. In 1946 the average yield was 60 bushels. But during the 40 year period from 1900 to 1940 the average yield was less than 40 bushels per acre. During 1946 and 1948 there were many farmers who raised over 150 bushels per acre, and one farmer in 1948 (Carroll Brown at Rose Hill) grew 224 bushels of corn on one acre. The average yield of corn per acre in 1948 should have been close to 100 bushels per acre. The reason that the average yield was so much lower than 100 bushels is because the fertility of much of our land has been lowered through erosion and long-time cropping without addition of manure or fertilizer.

12. By the time you young people become of age so you can take over the management of farms in Iowa will the fertility of our soils be lower than today, or will fertility be improved?

A vigorous educational program has been under way, especially in recent years, in which many agencies have been cooperating toward encouraging farmers to use better soil management practices. The outlook now is very good that soils will receive better care than they have received in the past. There has been increasing interest recently among all people in good land use. There has been a great deal learned by research men in soil management which is now being practiced. More schools are teaching the importance of conservation practices.

13. Suppose we have a system of management on a farm so that all erosion is under control. Can we expect to maintain high yields without the use of fertilizers?

No. Simply holding the soil in place does not mean that the fertility is being maintained. Provisions have to be made to return organic matter and plant nutrients to the soil in order to maintain or increase soil fertility.

14. It has been pointed out that we produced only 61 bushels of corn in 1948 instead of 100 bushels of corn per acre in Iowa because so much of our land has been abused. Can we rebuild our eroded and depleted soils so that in 20 years we may expect to raise 100 bushels of corn per acre in Iowa?

Yes, by the use of a good soil management program on all the farms in Iowa.

15. Outline the practices in soil management that will enable us to reach the goal of 100 bushels of corn per acre in Iowa.
   (a) Control erosion through contour tillage, terracing, strip-cropping, etc.
   (b) Practice crop rotation to include a legume hay crop like corn-oats-clover or corn-corn-oats-alfalfa-alfalfa.
   (c) Use lime on acid soils.
   (d) Use all available barnyard manure, and turn under all crop residues.
   (e) Use tile for draining soils where the water table is too high.
   (f) Use commercial fettilizers where needed in accordance with soil tests.
   (g) Plant the best adapted crop variety.
   (h) Control weeds by cultivation and spraying with chemicals.
   (i) Control insects by use of chemicals.

16. How can a farmer decide whether or not his soil needs lime?
   (a) Several commercial test kits are available for determining the degree of acidity or alkalinity. The Ames Soil Testing Service, Ames, Iowa, sells a kit for determining lime requirement, and has a table of lime recommendations for Iowa soils.
   (b) The farmer can have his soil tested for lime requirement by sending samples to the Soil Testing Laboratory, Ames, Iowa.

17. How can a farmer determine his fertilizer needs?
   (a) The best practice would be to send a sample to the soil testing laboratory at Ames, Iowa. The soil testing laboratory will tell the farmer the kind of fertilizer to use for the different crops he wants to plant.
   (b) The County Extension Director keeps a supply of boxes for farmers to use when sending samples to Ames. He also has copies of instructions on how the samples should be collected.

18. Why are legumes so important in the rotation?
   (a) About 80 percent of the atmosphere is nitrogen but the nitrogen of the air is not available to plants. The nitrogen must be combined with hydrogen or oxygen before

the plant can use it. Certain bacteria which live in the nodules on the roots of legumes are able to take the nitrogen from the air and combine it with other elements so that plants can use the nitrogen. As much as 100 pounds of nitrogen per acre may be combined in one year by the bacteria living with alfalfa or sweet clover. This nitrogen would cost the farmer about $11.00.

(b) Another important result of having a legume in the rotation is that the soil has a desirable granular structure when the legume-hay sod is plowed up. The good structure helps to reduce runoff and erosion and permits good soil aeration.

(c) In summary, a legume hay crop in the rotation increases corn yields and reduces soil loss.

19. How does farm manure compare with commercial fertilizer in its effect on corn yields?

(a) A load of farm manure contains about:

10 pounds of nitrogen worth about	$1.10
5 pounds of phosphoric acid worth about	.45
10 pounds of potash worth about	.80
TOTAL	$2.35

(b) It has been estimated by the Agronomy Department at Ames, Iowa, that an average load of manure is worth almost as much as a 100 pound bag of 4-16-8 or 3-12-12 fertilizer in effect on corn yields.

(c) Farm manure is low in phosphorus compared to nitrogen and potash. A farmer who uses manure on fields low in phosphorus should plan on using phosphate fertilizer if he wants high crop yields.

(d) Farmers should be as careful to protect manure as they would be careful in protecting bags of commercial fertilizers.

20. Many of us have thought that Iowa soils were so fertile that we would never need fertilizers in our lifetime. How much fertilizer is used in Iowa now compared to ten or fifteen years ago?

21. Do soils vary in their needs for fertilizers?

Yes, soils vary considerably in their need for fertilizers. One soil may need only phosphorus, another may need only potash, another may need nitrogen and phosphorus. The only way a farmer can be sure of the kind and amount of fertilizer is to have his soil tested.

22. Will plants show signs of hunger for a certain element?

Plants show signs of hunger for certain elements only when the element is extremely low. A farmer may have low yields because of low fertility and still not have plants showing hunger signs. Corn leaves turn a purple-red color when phosphorus is lacking. Corn leaves turn yellow down the midrib when nitrogen is lacking. The lower leaves may turn yellow and die when nitrogen is very low. The edges of corn leaves turn brown while the middle of the leaf stays green if potash is deficient.

23. Now that we have discussed soil fertility from many different points of view, we should ask ourselves just why do we want to improve the fertility of the soil.

(a) Fertile soils mean higher crop yields.
(b) Fertile soils mean healthier and better looking children.
(c) Fertile soils will produce high quality feeds which help us grow healthier livestock.
(d) Fertile soils will grow plants with higher food value.
(e) Fertile soils support good pastures which will cause cows to give more and richer milk.
(f) Fertile soils mean higher farm income.
(g) A community with fertile soils will have better schools, better churches, better roads, and more facilities for recreation.
(h) Fertile soils mean a higher standard of living and happier and more healthful lives.

C. Suggestions for Pupil Activities:

Test at least one sample of soil for lime requirement from each pupil's farm. Materials for determining ph and lime requirement can be purchased from the Ames Soil Testing Service, Box 445, Ames, Iowa, for $2.75. The materials include indicators, spot plate, and color chart along with instructions and recommendations for lime.

1. To illustrate the relative value of different kinds of plant food nutrients, take several tin cans of uniform size. Punch a few small holes in the bottom. Fill three-fourths full of sand. Add one-half teaspoonful per pint of sand of such fertilizers as are obtainable and which are to be compared (e. g., superphosphate, ammonium nitrate, mixed fertilizer, barnyard manure). Leave one can containing only pure sand as a check. Mix fertilizer well with the sand. Plant oat kernels and cover with more sand. Place in saucers and keep well watered at room temperature. Compare rate of growth, height, and color of plants.
2. Find out all you can in your encyclopedia, or other references, about photosynthesis (the process of manufacturing food in the leaves of the plant).
3. Show how plant food, carried by water, is transported from the soil through the roots and stem to the leaves. This can be demonstrated by placing a celery stalk in a glass of water colored with red ink.
4. Dig up several kinds of legumes and note the presence of nodules on the roots. Explain the function of these nodules. Show samples of inoculation material and tell how it is used. If possible examine nodules through a microscope.
5. Mixed commercial fertilizers are always designated by a series of three numbers such as 4-16-8. These numbers indicate the percentage of the available amounts of each of the three plant nutrients—nitrogen, phosphorus, and potassium, in the order named. Find out the formulas for several mixed fertilizers used in your neighborhood. Assuming nitrogen to be worth 11 cents per pound, phosphorus 9 cents per pound, and potassium 8 cents per pound, find the value of these plant foods in a ton of each of the various kinds of mixed fertilizers.

D. Culmination of Unit:

The teacher should endeavor through skillful questioning and review to get from the pupils the following information in summary form: Plants are made of elements which come from the air and from the soil. In the plant, these elements become the foods that feed animals. Man gets his food either by eating plants or animals.

If the soil is poor in certain elements, not only the plants but the animals feeding on the plants, may suffer from lack of the elements.

We do not have to worry about the elements which come from the air for they follow a regular cycle from air to plant, to air again. Nitrogen can be classed as one of these in some respects for legumes inoculated with the right bacteria can take nitrogen from the air as well as can certain free-living bacteria in the soil. By free-living bacteria we mean those which can live by themselves in the soil without having to live on some other plant such as a legume.

All the other elements come from the soil. If any one of the essential ones is lacking the plant won't grow. When they are low or lacking, they must be added as fertilizer. Nitrogen, phosphorus, and potassium are the ones most commonly used in fertilizers. Others are sometimes needed, however. Besides getting nitrogen in fertilizer, it can be added by growing and plowing under inoculated legumes or by feeding the legume hay and putting the manure on the land.

One of the best ways to conserve on soil nutrients is to save every bit of manure possible. One should handle it in a way to reduce losses from scattering, loss of the liquid portion, leaching or washing action of rain water, melting snow and ice, and to keep it from drying out.

When soils are acid or sour, lime must be added.

We all have a definite responsibility to maintain a proper supply of nutrients in the soil.

III. REFERENCES:

A. Science Text Book Series:

GRADES 1-4 inclusive.

Curriculum Foundation Series.....Scott, Foresman and Co.
Discovering Our World, Book I 166-168, 208-212

Scientific Living Series.....L. W. Singer Co.
The How and Why Club 116-143

Wonderworld of Science Series.....Scribner's
Book One 103-119
Book Three 7-27

GRADES 5-8

Adventures in Science.....Allyn and Bacon
With Jack and Jill 243-253
With Ruth and Jim 253-261

Basic Science Education Series.....Row, Peterson and Co.
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Curriculum Foundation Series.....Scott, Foresman and Co.
Discovering Our World, Book II 177-203

Iroquois Science Series.....Iroquois Publishing Co.
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Book Six 15-36, 243-248, 258-262
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B. Miscellaneous References:

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Iowa State College	Fertilizers for Field Crops	Agr. Extension Service, Bulletin Office, Iowa State College, Ames, Iowa
Mickey, Karl B.	Health From the Ground Up	International Harvester Co., Chicago, Ill.
Peterson, J. B.	Let's Save Our Soil	Iowa State College, Ames, Iowa
Plant Food Council	Our Land and Its Care	American Plant Food Council, Inc., Barr Bldg., 910 17th St., N. W., Washington 6, D. C.
Reh and Wheat	Science and Life (Books One & Two)	American Book Co., Chicago, Ill.
Thompson-Green	Good Health from Good Soil	Wm. C. Brown Pub. Co., Dubuque, Iowa
University of Tennessee	Elements of Life	University of Tennessee, Agricultural Experiment Station, Knoxville, Tenn.
Zeasman, O. R., & Clark, J. W.	We Can All Help Save Our Soil	Extension Service, College of Agriculture, University of Wisconsin, Madison, Wisconsin

Unit VIII — FARM CONSERVATION PLANNING IN IOWA

Winter — 1951, 1954, 1957

I. TEACHER'S OBJECTIVES:

To help the pupils understand:

A. That portions of land on any one farm may be adapted to different uses.

B. That soil treatment needs (such as limestone and commercial fertilizer) may be different on *different areas* of *any one* farm.

C. That the kinds and numbers of livestock may need to be changed on an individual farm to make good use of the feed produced.

D. That definite farm conservation plans are necessary to get an effective conservation job done on individual farms and groups of farms.

E. How and through what processes farm conservation plans may be developed.

II. PROCEDURES:

A. Approach by the teacher to the pupils. (The teacher will read the following statement to the pupils or tell the story in her own words.)

In our science course last year we learned something of our soil waste. We learned that without soil there can be no soil-loving plants of any kind. We learned that when our top soil is lost we have had the three most important things of life taken away from us, namely, food, clothing, and shelter.

It is true that we have learned some of the little things that we can do to help stop erosion. You have been on field trips and have seen how contour cultivation, terracing, and grass waterways help keep the soil from washing down the streams and rivers.

Farming is the largest single "business" in Iowa. In order that your parents and your neighbors can use their farms to secure the greatest production and at the same time save the soil for continued use, the conservation practices must be fitted to the farm. This requires careful planning. We call this kind of planning Farm Conservation Planning.

I would like to tell you how the farmer and the soil conservationist work together in making a Farm Conservation Plan.

First of all the district commissioners of our County Soil Conservation District believe that more can be done if farmers will work together as a group in developing their farm conservation plan. We know that erosion problems on one farm may affect what can be done on a neighboring farm. The farmer and his neighbor may ask the district commissioners for help in farm conservation planning. Some of the commissioners, the County Extension Director, or the Soil Conservation Service technician will meet with this group of farmers to discuss general problems and what they think should be done.

This group of farmers will probably meet two or three more times with the conservation technician to make further plans as to how they are going to take care of their conservation problems.

These meetings may be scheduled a week or more apart. Between these meetings the technician will plan to work on each individual farm with the farmer. They walk together from field to field, studying each piece of land as they go and checking with the soil survey map of the farm. This map has been prepared by a soil surveyor. The map shows the different kinds of soil, the slope of each parcel of land, the amount of erosion that has taken place and some other problems. They see what each field is used for, and what the map shows it should be used for. They examine every acre, including the pasture and the woodland.

The farmer tells the soil conservationist what he grows, what kind of farming he wants to do, what livestock he has, what machinery he has, etc. The soil conservationist points out in every field what should be done to stop erosion and keep the land productive.

Fences and farm roads may need to be moved in some places so that they follow the contour of the land and fit in with the terraces and contour farming. Field boundaries may need to be changed in some places so that each field will have nearly all of one kind of land. Some crop land may need to be changed to pasture, meadow, or woods. There may be some idle land that can be drained or cleared of brush or trees to prepare it for growing crops.

The farmer with the help of the conservationist decides upon the soil treatments, such as limestone and commercial fertilizers, and the conservation practices to be used on each field. They plan these practices for the years ahead. Terraces may be needed on some fields, contour tillage and stripcropping may do the job on others. Cover crops or green manure may be needed on some fields. If stock water ponds are needed, sites for them will be chosen. Some fields may need to be tiled for better drainage. The sites for waterways will be chosen, and other practices must be carefully considered and decided upon.

When the details are agreed upon, the farmer and the conservationist put them down in a written plan which includes a simple farm map. This plan becomes a cooperative agreement and is signed by the farmer and your ———— County Soil Conservation District Commissioners. The farmer is then ready to place the conservation practices on his farm with the help of the Soil Conservation Service Technician.

What can you children do to encourage farm conservation planning on your home farms and in your neighborhood? Everyone, no matter how small, can do something.

Let's resolve to learn of some of the things we can do to help develop such plans and to do the job of conservation.

B. Presentation of the Problem:

1. We will take a few minutes to think about some of the conservation problems you have heard your parents and neighbors talk about regarding the farms in your community.
2. List on the blackboard the suggestions made by the pupils.
3. Draw out suggestions which will probably include the following:
   a. Are there differences in the land in your community? (Steep, flat, eroded, wet, boggy, infertile, etc.)

4. What are some of the practices which should be followed in order to make the best possible use of all of our land? (List on board such things as liming, rotation of crops, drainage, pasture management, contouring, terracing, stripcropping, livestock feeding and management.)

C. Suggestions for Pupil Procedure:

1. Draw a map of your farm or some neighbor's farm, showing crops that are being grown at the present time. Show, by rough sketch, the drainage ways, ditches, and gullies, and show by arrows the direction or slope of the land.
2. Reproduce some of these maps, one at a time, on the blackboard. Discuss, as a group, questions such as the following:
   a. Is there a difference between the soil in field A and field B? Why is there a difference?
   b. Is this soil difference being recognized by the farmer as shown by the present field arrangement on the farm?
   c. What effect, in terms of erosion, is the present plan having on the soil?
   d. Are fields being cultivated in such directions as to encourage erosion by water? (Review previous work on rills, gullies, sheet-erosion, etc.)
3. Find out what kind of crops are being grown in the rotation on this farm, also the number of years each crop is grown on each field.
4. Take the map home and discuss such points as the following with your parents:
   a. Does the entire farm need limestone?
   b. How can we test soil for limestone? (Samples from each field can be sent to Iowa State College, Soils Department, Ames, Iowa, for testing.)
   c. Are commercial fertilizers used and are they needed on the farm? (Same soil samples can be used to test for fertilizer needs. Soils technician or County Extension Director can show how to take soil samples.)
   d. Are conservation practices such as contouring, terracing, grass waterways, farm ponds, etc., needed on this farm and are they being used?
5. Take a field trip to some farm in your community that is being planned by the farmer and the soil conservationist. Ask them to explain the changes being made, reason for the changes, and expected results in terms of increased production, less loss of soil by erosion, etc. What changes are being made in number and type of livestock in order to best utilize the food being produced?
6. Locate the names and addresses of your District Soil Commissioners, your District Soil Conservationist, and your County Extension Director. Write to one or more of these men asking them how the Soil Conservation District helps farmers develop Farm Conservation Plans. Read and discuss the answers to these letters. Every county has one or two vocational agriculture classes where help and information in these projects can be secured. Many pupils have brothers who are Future Farmers in vocational agriculture classes who are studying these things

and carrying out projects. Find where all these persons are available and enlist their help.

7. Discuss: What effect would the application of Farm Conservation Plans to the farms in this community have on our future agriculture, our standard of living, etc.
8. Discuss: Why is the help of trained soil conservation technicians being made to farmers in developing Farm Conservation Plans and in getting conservation on the land?

D. Culmination:

Review in conversation, important aspects of this unit. Help pupils to make a series of summarizing statements such as:

1. We have learned that certain soil treatments such as agricultural limestone and commercial fertilizers may be necessary to build and keep fertility.
2. We have learned that many conservation practices, such as contouring, terracing, stripcropping, tiling, stock water ponds, etc., may be necessary in order to keep the soil from washing away.
3. We have learned that these must be planned for in order that they will fit the farm and make it possible to use the land properly.
4. We have learned that we can help in a small way to start developing a conservation plan for our home farms.
5. We have learned that the general livestock management program, in regard to numbers and types of livestock, may have to be changed in order to fit in best with the Farm Conservation Plan.

GLOSSARY

1. Carrying Capacity—The amount of livestock an area of pasture will feed through a grazing season.
2. Contour Furrowing—Plowing furrows on the level to hold rainfall to help the growth of pasture grasses.
3. Cover Crops—Dense growing crops (small grains, legumes, etc.) on cultivated areas at times when there are few other plants to protect the land from erosion.
4. Crop Rotation—Alternating various crops on a piece of land to keep the soil productive and to improve it. Example: corn one year, oats the next year, and clover the third year on the same piece of land.
5. Drainage—Removal of excess water from wet areas by ditches or by tile drains.
6. Exhaustion of Plant Food—Excess removal of plant nutrients from the soil in agricultural products taken from the land.
7. Farm Conservation Plan—A plan for the use of all land on a farm according to its needs and ability to produce, and the farmer's desires and facilities.
8. Field and Gully Planting—Planting eroded or gullied areas not suited to cultivation, to trees, shrubs, grasses, or other useful plants that will help stop erosion and conserve rainfall.
9. Grazing Season—The part of the year animals can be profitably pastured on an area without permanent damage to the land or grass.
10. Gully Control—Using plants and mechanical measures (dams, flumes, etc.)

11. Management of Odd Areas—Developing fence corners, rocky areas, sinkholes, etc., for wildlife purposes.
12. Pasture Development—Establishing new pastures with selected grasses and legumes, and combination of grasses and legumes.
13. Pasture Improvement—Using measures that will increase the growth and will improve the quality of pasture grasses.
14. Permanent Pasture—Areas used continuously for pasture.
15. Pond Management—Use of suitable measures to protect ponds from erosion and siltation and to aid in the production of fish and other pond wildlife.
16. Runoff—Part of rainfall (or snow) that runs off the land into neighboring drainage-ways.
17. Shelterbelts and Windbreaks—Plantings of trees and shrubs in strips or "belts" to deflect wind currents, thus reducing wind erosion and drifting snow.
18. Soil-saving Dams—Dams built of earth, rock or other local materials, across gullies or natural water-courses, to catch silt, slow down runoff, and reduce erosion.
19. Sound Land Use—Using every acre according to its ability to produce, with methods that maintain the productivity of the land.
20. Strip Cropping—Planting strips of close-growing plants (like grass or clover) between strips of clean-tilled row crops, on or nearly on the contour.
21. Technicians—Technically trained men who assist with the soil conservation job of treating all the land of the farms according to capacity to produce and according to needs.

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A. *Our American Land, The Story of Its Abuse and Its Conservation.* Miscellaneous Publication No. 596, U. S. Department of Agriculture, Soil Conservation Service.

B. *Let's Practice Soil Conservation for a Permanent Agriculture.* International Harvester Co., 180 N. Michigan Ave., Chicago 1, Illinois.

C. *Your Land,* Bethlehem Steel Co., Bethlehem, Pa.
(For general references on Soil Conservation, refer to those listed under Unit One, *Our Dependence on the Soil.*)

Unit IX — LEGUMES AND GRASSES IN CONSERVATION

Spring — 1952, 1955, 1958

I. TEACHER'S OBJECTIVES:

A. To help the pupil recognize some of the important legumes and grasses and their uses in agriculture.

B. To help the pupil realize that when high quality productive legume-grass combinations are properly used in the farm operations they will:

1. Reduce soil and water losses.
2. Give maximum vegetative protection and make possible the best performance of such mechanical soil conservation practices as contouring, terracing, strip-cropping, etc.
3. Maintain or improve productivity of soils.
4. Increase the organic matter content in soils.
5. Improve efficiency in livestock feeding.

II. PROCEDURE:

A. Approach—Teacher to the Pupils:

When the pioneers first came to Iowa the entire state was covered with timber along the streams. The open land was covered with legumes and tall grasses. The pioneer farmer cut down the trees and used the cleared area for growing his crops. This was necessary because he had no plow that could turn under the prairie grasses. He was unable to plow this grass land until the steel moldboard plow was developed. Following the development of the steel moldboard plow, the pioneer plowed under the prairie grass land, planted large acreages of corn and grain crops, and started the movement that has now taken from these soils a considerable portion of their organic matter and fertility. It has become necessary, therefore, for the farmer to grow more legumes and grasses in order to restore some of the soil's fertility. But because some of the legumes and grasses originally used by farmers did not fit well into a cropping system, it was necessary to develop improved varieties. We are going to learn about legumes and grasses and how problems relating to them are being solved. Here are the study questions for those problems.

(Teacher will list the following topics on the blackboard and encourage pupils to read all possible references to find answers. When the classes meet to discuss these problems, the teacher can refer to the answers given below.)

B. Study Guide—Questions and Answers:

1. Name the common legumes and discuss their value, how they should be planted, how they use nitrogen from the air.
   a. Alfalfa is the best legume hay crop. Nearly all soils in Iowa can be treated so as to grow good crops of alfalfa. Unless a farmer is sure that his soil is high in phosphorus, he should always plan to apply superphosphate fertilizer when he plants alfalfa. Furthermore, the soil should be limed, if needed, before alfalfa is planted. Lime should be applied several months before planting time.

Alfalfa is a perennial, which means that the plant will grow for many years with one seeding, but a disease known as bacterial wilt, which enters the plant through the roots, often kills many plants and reduces the stand by the end of the second or beginning of the third crop year. There are two new varieties of alfalfa, Ranger and Buffalo, that are less affected by bacterial wilt, but the seed is not yet plentiful.

Ranger is adapted to all the state while Buffalo is adapted only to central and southern Iowa. Until there is plenty of seed available for the wilt resistant varieties, it is best not to leave alfalfa growing for longer than three years. A stand of alfalfa will yield about three cuttings a year amounting to about three tons or more of hay during the season. Care must be taken not to cut hay, or pasture alfalfa, too late in the season or winter killing will be the result.

b. Red clover is actually a short lived perennial but we use it as a biennial, which means that it grows two years from one seeding. This legume is first choice for farmers who want only one year of meadow following oats in a rotation. It does not need as much lime as alfalfa, but red clover is considered a lime-loving crop. Like alfalfa, red clover seedings should be made along with an application of superphosphate.

Red clover is planted at the same time as oats are planted, and timothy is usually seeded with red clover. The crop should be allowed to grow without grazing or cutting during the first year. One may expect two cuttings of hay from red clover. However, some farmers make only one cutting of hay early in the summer. They use the meadow for pasture the rest of the season or cut it for seed. Even with two hay crops, one may get a few weeks of pasture from a red clover-timothy meadow.

c. Sweet clover may be divided into two groups:
   (1) Annual sweet clover is known as Hubam.* This crop is not a hay crop. It may be used for pasture, but its greatest value is for plowing under as green manure. It is most popular in north central Iowa on heavy soils that are fall plowed. The clover is planted with the oats and then turned under in the fall.
   (2) Biennial sweet clover is grown for pasture and green manure. It is planted with oats and turned under in the spring of the following year before planting corn. Both Hubam clover and biennial sweet clover are lime-loving legumes. Furthermore, they have a very high requirement for phosphorus. Where sweet clover is grown for green manure it is wise to add superphosphate at planting time. The phosphorus will be taken up by the plant to increase the amount of green manure, but will be released in available form for corn as the green manure decays.

d. Lespedeza is a legume that has a lower lime requirement than any of our legumes for pasture or meadow. It will

* Named for Professor H. D. Hughes of Iowa State College who made the plant known, and for Alabama where the plant originated.

grow on acid soils of southern Iowa where other legumes fail. Lespedeza is an annual and must mature a seed crop in order to maintain itself. It is, therefore, adapted to southern Iowa where the growing season is long enough for production of seed.

Lespedeza may be seeded with Kentucky blue grass for permanent pasture or with oats for rotation pasture.

e. Ladino clover is a giant white clover which has become very popular in Wisconsin, and shows great promise for the northeastern dairy section of Iowa.

Ladino clover has a high moisture requirement and cannot stand hot and dry weather. It is recommended in eastern Iowa where drouth is least likely in the state.

f. Legumes help improve soil fertility because they add nitrogen to the soil. Certain bacteria live in the nodules (small swellings) on the roots of legumes. These bacteria take nitrogen from the air to make plant food. When the legume residues are plowed under, nitrates are formed which are used by the following crop.

2. Discuss some of the outstanding features of each of the grasses.

a. Bromegrass is the number one grass in the United States as far as palatability (preference by livestock) is concerned. It is well adapted to the soils and climate of Iowa and is particularly well adapted to growing with alfalfa. Bromegrass is planted with alfalfa at the same time the oats are planted in the spring. As mentioned above, the brome and alfalfa are allowed to grow without cutting, or grazing, during the first season. It may be used for hay and pasture for several years, but after the fourth year, the stand of alfalfa cannot produce all of the nitrogen the bromegrass needs and it makes very little growth after that time. Farmers say the meadow is "sod bound" when the growth of grass is so small. This condition can be corrected by fertilizing with nitrogen but the best practice is to plow up the meadow and start over in the rotation by planting corn the following year.

b. Timothy is well adapted to Iowa and has been the leading meadow grass for many years, but may take a second place to bromegrass. Timothy and red clover make an especially good combination where there is only one year of meadow in the rotation. Timothy makes a heavy growth the second year at the same time that red clover is making its greatest growth. Timothy is especially popular in the southern half of the state.

3. How can farmers increase grass and legume acreages?
Every farmer who grows corn should include legume-grass hay or pasture in a crop rotation system. For convenience we shall refer to the grass-legume hay as a meadow.

4. How much of Iowa crop land is planted to meadow?
About one-sixth of Iowa crop land is planted to meadow at the present time. Over half the crop land is planted to corn and about one-fourth of the crop land is in oats. The remainder of the crop land is in soybeans, wheat, flax, etc.

5. What is considered to be a good crop rotation for Iowa?
Our best level land soils can be planted to a four-year rotation of corn-corn-oats-meadow and still maintain productivity of the soil. But we have some soils which are not so fertile, and a rotation of corn-oats-meadow-meadow would be best for maintaining soil productivity. Other rotations are corn-oats-meadow, and corn-corn-oats-meadow-meadow.

   If all Iowa crop land were good enough for the corn-corn-oats-meadow rotation we would have one-fourth of our crop land in meadow crops, which is more than we have in meadow now. If all the crop land were in a corn-oats-meadow-meadow rotation then one-half the land would be in meadow. The best estimate that we can make now is that about 30 percent of Iowa crop land would be planted to meadow crops (grasses and legumes) if every farmer were following a rotation best suited to his soil.

6. We now have about one-sixth of our crop land in meadow and we should have about 30 percent of the crop land in meadow. There are about 21 millon acres of crop land in Iowa. How much should we increase our meadow acreage?

   The acreage should be increased from about 3½ million to about 6½ million which would almost double the land planted to grasses and legume mixtures.

7. Why do we always say corn-oats-meadow in that order?
The rotation of crops follow in the order mentioned. Legumes and grasses, which make good hay crops, should be planted with oats. If the legumes and hay grasses are planted without oats they may be crowded out by weeds. The oats are harvested in early summer. The young grass and legume plants should be allowed to grow the first season without being cut for hay. Animals should not be allowed in for pasture. The following year the meadow may be used for hay or pasture. Most farmers make one or more cuttings of hay, and then use the meadow for pasture until fall. Sometimes late summer seedings of grasses and legumes are made without a companion crop of oats.

8. List the most important grasses and legumes for use in a rotation meadow.

Grasses	*Legumes*
1. Brome (Southern strains)	1. Alfalfa
2. Timothy	2. Red clover
	3. Sweet clover
	4. Lespedeza
	5. Ladino clover
	6. Alsike clover

9. Only the grasses and legumes for *rotation meadows* have been discussed. What are some of the important grasses and legumes for *permanent pasture*?

Grasses	*Legumes*
Kentucky blue grass	Birdsfoot trefoil
Reed canary grass	

10. What are the merits of permanent pasture plants?

a. Kentucky blue grass is so widely distributed in Iowa that it may be found along almost every roadside. This grass comes in naturally in permanent pastures. It can be seeded, and should be seeded, where permanent pasture is being established. As a general practice, it would be better to lime and fertilize a soil for growing alfalfa and bromegrass rather than seed Kentucky blue grass if cultivation of the soil is safe from the standpoint of erosion. Much of Iowa land, particularly in southeastern Iowa, is not suitable for cultivation. Under such conditions one must look to Kentucky blue grass.

b. Reed Canary grass is the best grass we have in Iowa for poorly drained soils or for planting along wet drainage ways. This grass can stand silting without injury, and is adapted to creek bottoms where several inches of soil may be washed in during flood time.

c. Birdsfoot trefoil is a legume which gets its name from the arrangement of pods. It is a perennial which shows great promise for southern Iowa. This legume grows well in combination with Kentucky blue grass. It is quite drouth resistant and does well even on poor soils. Birdsfoot trefoil does well on poor soils, but like other forage legumes, birdsfoot trefoil responds well to lime and phosphate fertilizer.

III. REFERENCES:

A. Iowa Farm Science Reprints:

Number	*Title*
45	Brome grass
97	Birdsfoot trefoil
105	Lespedeza is here to stay
110	Sweet clover on Iowa farms
117	Let's examine crop rotations
120	Better alfalfa coming
124	Fertilize the oat crop
127	Building better pastures
145	Mammoth or medium red clover
167	Cover crops help save the soil
157	Fertilize for better hay
183	Let's remodel our pastures

B. Miscellaneous:

Peterson, M. L. & Hughes, H. D.
Modernizing Pastures
Bul. P86
Iowa State College

C. Science Textbook Series:

Our World of Science Series.....Ginn and Co.
New Ideas in Science 316-318
Wonderworld of Science Series.....Chas. Scribner's Sons. Co.
Book 8 136

HOW CONSERVATION IS BEING TAUGHT

If we had waited until every teacher in the elementary grades had been trained to teach the conservation of our natural resources, we should never have started. Conservation isn't something that can wait. And so, the teaching of it has been going on in the rural schools of some counties of Iowa for ten years or more—in counties where conservation-minded superintendents have given excellent leadership, and where there is very active cooperation between his office and one or more of the various conservation agencies of the county. The intention of all such teaching has been threefold: (1) To give teachers some in-service training; (2) to make the teaching of conservation as functional as possible with emphasis on *doing* rather than talking and (3) to make use of all available help offered by outside agencies interested in promoting conservation of our state's natural resources.

With the help and encouragement of various agencies interested in conservation the Soil Conservation Service, the Izaak Walton League, the Extension Service of Iowa State College, 4-H Clubs, The Farm Bureau, The Conservation Commission, The Conservation Committee, Rotary Clubs, Chambers of Commerce, the AAA, and the various State newspapers, many schools have engaged in a number of worthwhile projects. A few are cited as follows:

At some schools in areas where the erosion problem is acute, the Soil Conservation Service (SCS) sponsors plantings of grasses and legumes and wildlife cover. Pupils help do the work. Parents of the children are asked to observe these plots and to inspect the grasses and legumes recommended for grassed waterways, gullies and improved pastures and meadows.

Pupils draw maps of the farms where they live and write stories telling of actual procedures of soil saving and soil building which are being used by their parents.

Field trips are taken by teachers and/or pupils to nearby fields to observe erosion and methods of prevention; some schools visited the U. S. Experimental Farm and the Nepper Watershed Project in Monona County.

Children are observing gullies being dammed. They are learning how terraces, grassed waterways, diversion ditches, etc., are being constructed. They find out how land that is too steep for cultivation is being restored to pasture and meadow land. Children and teacher visit these areas and discuss them. They learn to recognize every type of conservation problem, and how to cope with it by contouring, strip cropping, and gully-stopping.

Hundreds of trees acquired at minimum cost are planted to prevent erosion. One school has planted one tree in its school yard for the past four years. The children have planted and culled trees with the aid of parents and by following directions given at school.

Children watch and study contouring on farms adjacent to school. They summarize their discoveries as part of an annual record for each year's conservation contest.

In one county an Achievement Day based on conservation practices is planned by a Chamber of Commerce. Each rural school in the county is required to submit a notebook on conservation at the close of the year. These booklets are judged by a committee composed of representatives from the Farm Bureau, the AAA and the Soil Conservationists. Financial awards are given for the best township booklets and the three best of the county. The award is given to the school since this is a school project and all pupils from grades 1-8 participate. Winners of the awards are given an airplane ride.

Rural pupils are grouped in centers to view conservation films under the direction of the Soil Conservationist. Parents are invited, and many attend these centers.

Pupils make maps of their own farms and show conservation practices which are being carried on, or maps which show where such practices should be carried on. Such activities have worked wonders in creating parent interest in improving the soil.

Pictures are taken of farms showing contour farming and gully improvements. These are found in many of the notebooks.

Trips are made under the direction of the Soil Conservation Committee to the following: (a) farms which are worn out and where nothing has been done to improve the soil; (b) farms which are caring for their soil; (c) Agricultural Experimental Station.

In one school each child has attempted to carry out one project in conservation at his home. One boy has undertaken the filling in of all ditches and gullies on his father's farm.

Pupils in one rural school crossed two farms as they came across the fields to school. They observed these farms. One had a soil conservation program and the other had no plan, but it had some erosion that needed to be stopped. At a meeting of the Parent-Teacher Club at this school, the pupils gave a program on soil conservation. They brought out their observations as to conditions on the two farms which they crossed daily on the way to school. As a result of their discussion the farmer on the farm which had no conservation plan became interested in the problem and sought help of the Soil Conservation Agencies in the county. Now he is practicing various conservation measures on his farm.

Pupils in one school made a plan for the farm on which their school stood. They built a model of the farm and showed which fields they thought should be contoured, where gullies should be healed, where planting trees would help, where pastures would be more profitable than field crops, and some places which they thought should be terraced.

School children all over the state have set up shelters and feeding stations for game birds. Shelters are constructed of corn stalks or tree branches, or hygeria stalks, or discarded Christmas trees. Feed is put into these shelters at regular intervals. These splendid undertakings have often been sponsored by various adult organizations and individual sportsmen. Feeding stations for other winter birds have been set up in school yards, on tree trunks, and on school window ledges.

In one county the Izaak Walton League sponsored a feed-distribution for game birds to the amount of 1350 pounds of hayseed sortings, 700 pounds of corn, and twenty tons of hygeria weed.

Another project deserving mention is that done by a group of teen-age boys who weeded the multiflora rose bushes planted at a game refuge.

Teachers find it inspiring to teach conservation of our natural resources to all pupils, regardless of age or grade. It is true as ever that "as the twig is bent, the tree is inclined," and while some children may be indifferent to conservation teaching which they receive in their adolescent years, it is not likely to be so with children who have become imbued with the soul stirring ideals of conservation in their formative, impressionable years. What we have failed to do to other young, impressionable minds all through the last century bears witness on every hand. We need a "new generation of pioneers equipped with spirit and devotion and patriotism," says Louis Bromfield. Such activities as have been cited here give ample assurance that this new generation is now being equipped in our elementary schools.

GRADE LEVELS AT WHICH CONSERVATION TOPICS ARE TREATED IN SCIENCE TEXTBOOK SERIES:

Conservation of Soil

Series	Publisher	Grades
Adventures in Science	Allyn and Bacon	3, 5, 6
Curriculum Foundation	Scott, Foresman and Co.	3, 5, 6
Our World of Science	Ginn and Co.	2, 4, 6
Scientific Living Series	Singer Co.	1, 3, 4, 8
Wonderworld of Science	Scribner's	1, 3, 5, 8

Conservation of Wild Life

Adventures in Science	Allyn and Bacon	1-6 incl.
Curriculum Foundation	Scott, Foresman and Co.	1-6 incl.
Our World of Science	Ginn and Co.	1-6 incl.
Scientific Living	Singer Co.	1-5 incl.
Wonderworld of Science	Scribner's	1, 2, 4, 5, 7

Conservation of Water

Adventures in Science	Allyn and Bacon	3, 5, 6
Curriculum Foundation	Scott, Foresman and Co.	3, 4, 6
Our World of Science	Ginn and Co.	1, 2, 3, 4, 6
Scientific Living	Singer Co.	2, 4, 7, 8
Wonderworld of Science	Scribner's	2-7 incl.

Conservation of Minerals

Our World of Science	Ginn and Co.	4, 7
Scientific Living	Singer Co.	7, 8
Wonderworld of Science	Scribner's	5, 8

Conservation of Forests and Timberlands

Adventures in Science	Allyn and Bacon	1, 2, 3, 4, 6
Curriculum Foundation	Scott, Foresman and Co.	1-5 incl.
Our World of Science	Ginn and Co.	1, 3, 4, 5, 6
Scientific Living	Singer Co.	2, 3, 4, 5, 7
Wonderworld of Science	Scribner's	1, 3, 5, 7

Maintaining Soil Fertility

Adventures in Science	Allyn and Bacon	5, 6
Curriculum Foundation	Scott, Foresman and Co.	4, 5
Our World of Science	Ginn and Co.	7
Scientific Living	Singer Co.	4, 5, 7
Wonderworld of Science	Scribner's	1, 3, 5, 6, 7

Balance in Nature

Adventures in Science	Allyn and Bacon	1-6 incl.
Curriculum Foundation	Scott, Foresman and Co.	1, 2, 3, 5, 6
Our World of Science	Ginn and Co.	2-8 incl.
Scientific Living	Singer Co.	1-6 incl.
Wonderworld of Science	Scribner's	1-8 incl.