

HOW TO STUDY NATURE
IN ELEMENTARY SCHOOLS
A FLEXIBLE MANUAL
FOR TEACHERS

BY

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CONTENTS

PART I

CHAPTER	PAGE
I. Introduction.....	21
II. Qualifications of the Teacher.....	24
III. Objects of Nature Study.....	27
Material to be used.....	28
IV. The First Three Years.....	30
Animals.....	32
Astronomy and Meteorology.....	33
Plants.....	35
Insects.....	36
Divisions of Time.....	37

PART II

V. Fourth, Fifth, and Sixth Years.....	38
VI. Plant Study.....	41
Roots.....	45
Stem, stalk, trunk.....	45
Leaves.....	48
Buds.....	50
Seed Planting.....	51
VII. Stones and Soil.....	53
VIII. Birds, Beasts, and Insects.....	57

CHAPTER	PAGE
Birds.....	57
Animals.....	59
Insects.....	59
Caterpillars.....	61
Bees and Wasps.....	62
Ants.....	63
Beetles.....	64
Flies.....	64
IX. Collections.....	66

HOW TO STUDY NATURE



How to Study Nature in Elementary Schools

PART I

CHAPTER I

INTRODUCTION

Men fail in every department of human activity because they cannot see existing conditions. What they think they see does not exist, and they fail to discern realities.

Happiness depends to a large extent upon placing ourselves in harmony with our environment.

Success is due to our knowledge of and right use of the matter and natural laws and forces which are all about us.

Schools are necessarily artificial. Children are shut in, hedged about, and fed on the thoughts, experiences, and opinions of others. No wonder that long before maturity so many become satiated and tired of school and study.

“ When I heard the learn'd astronomer,

When the proofs, the figures, were ranged in
columns before me,
When I was shown the charts and diagrams,
to add, divide and measure them,
When I sitting heard the astronomer where
he lectured with much applause in the
lecture room,
How soon unaccountable I became tired and
sick,
Till rising and gliding out I wandered off by
myself,
In the mystical moist night-air, and from time
to time
Looked up in perfect silence at the stars."

—*Walt Whitman.*

Attempt to nourish a child on unsuitable food; feed him with a spoon at all times, and under all circumstances; give him the same diet every day without regard to his appetite; because food is a good thing, force down him all you can,—and he will be a stunted, physical imbecile before he is half-grown. The same is true of his mental growth, only it is not so apparent. Generally if one has a normal appetite, nature will keep him well and strong.

The chief work of a teacher is to create a mental appetite.

The most highly finished steam-engine is a cumbersome, useless thing unless there is hot steam inside. The so-called educated man is equally useless, unless he has within him an inward impulse that urges him onward to seek truth for its own sake.

The office of the teacher is to create that impulse. A child who leaves school hungry for knowledge, and who knows something about how to find it, is well educated. That being true, our effort should be not so much to teach this or that, or to pass a high per cent, as to train children to see and think for themselves, and to express clearly and truthfully the results of their observations and experiences.

A second-hand clothing store does not rank very high in business circles; but many teachers are jobbers of second-hand knowledge. It is necessary for children to obtain knowledge from books and teachers; but they should not receive all their information in that way. In order to understand and make a good use of the thoughts, experiences, and opinions of others, a child must have had experience in seeing and thinking for himself.

CHAPTER II

QUALIFICATIONS, OF THE TEACHER

You need an abiding desire to make the children wiser and better by their association with you; by some love for and sympathy with nature, and an appreciation of the value of a love of nature in the child's physical, mental, and moral development.

If you cannot secure these qualifications, have consideration enough for your children and respect enough for God's garden to let nature study alone. If you have the right spirit you can succeed at the beginning without technical knowledge. It will come as naturally to you as the rose to its parent stem.

Little children generally love nature until their sensibilities have been blunted by groping in the dark; and that darkness is too often caused by books and schoolhouse walls.

A little girl looking at the star-studded sky exclaimed, "Father, if the wrong side of heaven is so beautiful, what must the right side be?"

Everything that is from God is good. A mist goes up from muddy, filthy streets, and returns a mantle of pure, white snow. It is so with children. They are clean till they are soiled by contact with sordid things. It is the teacher's business to help parents to keep them clean; to lead them in the right way; to cultivate a good, sympathetic, considerate, warm heart until they are strong enough to choose that which is beautiful and good for themselves. You cannot do this altogether with chalk and paper and shoe-pegs, though these things are good enough in their way.

Nature is that part of God's thought which is visible to us and comes within our comprehension.

Our beautiful and beneficent world is like a great ship launched in the ocean of space, carrying upon herself every living creature. She is stored with supplies for every want not only of those who are here but of all who are to come. The wants of the birds and bees and of every creature are met, as well as those of the human race. There is not only enough that is needful and useful, but enough for all that is beautiful; there is food for the mind as well as for the body.

In the beginning, God saw that it was all good. Why may not we see some of its goodness and beauty ?

CHAPTER III

OBJECTS OF NATURE STUDY

Broadly speaking, the objects of nature study in school should be to supplement other lines of school work in such a way as to make them more effective in the highest and best development of the child, and to lead the mind into broader and richer fields than those which are ordinarily brought to the attention by the usual course of study in elementary schools. To be more specific, the objects of nature are to train pupils:

to observe,

to think,

to express thought,

to take an interest in nature,

to have a desire for knowledge,

to acquire information by their own efforts,

to get knowledge at first hand; and thus

to solve problems and decide questions without help.

In the lower grades nature study may be made

the basis for language, drawing, color study, and geography.

MATERIAL TO BE USED

The whole realm of nature need not be studied. *Our purpose is to give not information but power.* We are not to introduce the child to nature's multitudinous forms, but to give him a key with which he can unlock her secrets for himself. It is not indiscriminate, aimless seeing that we want, but rational observation with a purpose in it,—something that will produce a well-informed, thoughtful, considerate, useful member of society. The teacher's part is to direct the child's investigations; to train him what to avoid as well as what to choose.

The choice of material will be determined by the region in which the school is located; by the seasons, the weather, and the natural bent of teachers and pupils. Choose that first with which you can do most. It is not so much what you do as how you do it.

Great care should be taken to avoid those lines of study which have in them an element of cruelty. Children should be taught early that life is a most sacred thing and not to be

lightly taken. "Don't kill it!" is a good maxim. Knowledge gained at the expense of life is dangerous. Study the living creature rather than its dissected parts. All good creatures are entitled to life, liberty, and the pursuit of happiness. There is no more hopeful sign of the progress of humanity than the fact that hunters are beginning to photograph deer instead of shooting them. Encourage your boys to go hunting with a field glass and a camera.

Do not make nature study an excuse for filling your windows with a lot of unsightly boxes and tin cans filled with ragged, sickly plants. Have no more than you can well care for in neat, attractive jars.

Environment has as much to do with a child's development as heredity.

CHAPTER IV

SUGGESTIONS FOR STUDY DURING THE FIRST THREE YEARS OF SCHOOL

It is best not to have stated, formal lessons during the earlier years of school life, but to be governed by seasons and circumstances.

It is not expected that anyone will follow this outline literally, but each teacher is to select what may be used with profit.

BIRDS

In the early spring draw on the black-board a neat scroll and at the top print, "The coming of the birds." Request the children to be on the look-out for birds. When an arrival is announced, write the date, the name of the bird and the name of the pupil on the scroll, and let pupils talk about birds they have seen. This record should be kept until all the migratory birds have returned. The advent of butterflies and fire-flies may be noted in the same way.

Suggestive Questions

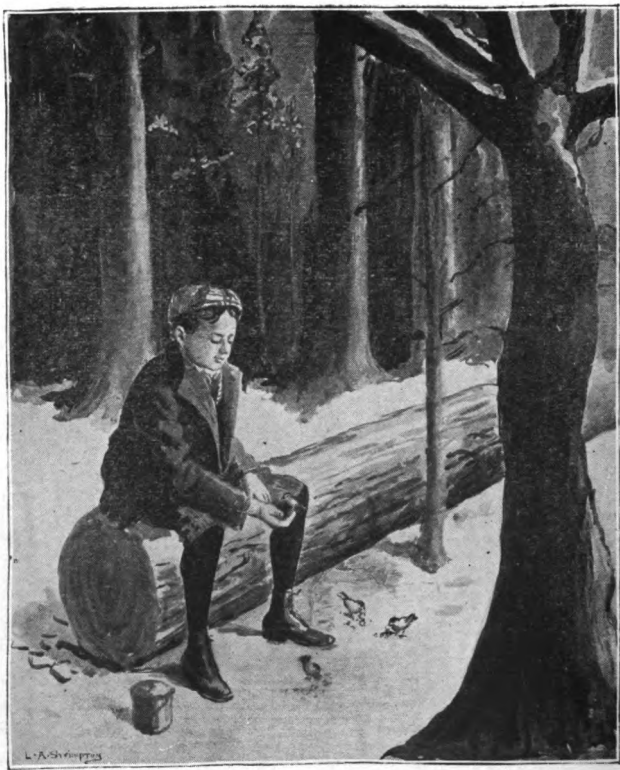
Where do the birds come from ?

Have they ever been here before ?

~~Bureau Nature Study,~~

CORNELL UNIVERSITY,

Ithaca, N. Y.



BIRDS EATING CRUMBS FROM THE HAND

Why have they returned ?

Do all birds go away and return again ?

Do you know any birds that remain with us all winter ?

Do we have to help the birds that stay with us during winter ?

What would happen if we did not help them ?

Are there any birds that do not need our help during winter ?

Are birds of any use to us ?

What do they do for us ?

Could we do without them ?

What do they live on ?

What kind of houses do they live in ?

Who builds their houses ?

How many children assist them ?

Some wild birds, such as the house-sparrow and chick-a-dee, may be trained to eat crumbs from the hand when the snow is deep in winter. To succeed one must be very quiet and patient.

Tell stories about the eider ducks, and the wild geese that build their nests in the frozen north countries. Borrow stuffed specimens, and show pictures. The Nature Study Publishing Company of Chicago supplies a good line of pictures

in connection with their magazine, "Birds". Let pupils make pictures of specimens and talk and write about them. If possible, show pictures of the great classes,—waders, swimmers, perchers, climbers, flesh-eaters, etc., and call attention to the form of the feet, legs, and beak.

Let the children learn and recite verses about birds, such as the Wood Pewee,—Trowbridge; the Lark,—Wordsworth; The Captive's Escape,—Mary Morrison; The Bob-o-link; The Stormy Petrel, etc.

ANIMALS

Familiar animals may be studied in the same general way. Do not try to impart technical information, but give side-lights from good literature and your own experience. Remember that "the letter killeth, but the spirit giveth life." Facts will come to the child as the results of his own observation. Home pets, puppies, kittens, rabbits, and the like, will be readily brought to school if asked for. These may be supplemented by stuffed specimens and pictures; but the living creature is always preferable. Let the children make pictures, relate experiences, and write about the habits, uses, and care of

familiar animals, as how to care for a horse, etc.

ASTRONOMY AND METEOROLOGY

Outdoor excursions are impracticable in most schools except on rare occasions. When indulged in, they should be more for recreation and social pleasure than for study. But by wise direction the teacher may lead children to observe many interesting natural phenomena, and, best of all, teach them to make a good use of time when left to themselves.

A weather record may be kept, in which may be noted the direction of the wind and condition of the weather each day. The prevailing winds in the locality will soon be learned. Note the direction from whence come the warm winds, the cold winds, and storms.

Direct the attention to the rising, and setting sun; the length and direction of shadows at different hours and seasons. The phases of the moon should be noticed, and some of the constellations of stars, especially the great dipper and the pole star.

Ask for information concerning form, motion, height, and origin of clouds. Tell your children to catch the big snow flakes on their sleeves or a

piece of dark cloth, notice their shape, and make drawings of them. Tell a story about the children who live in snow houses, and then ask for a picture of the house, and an account of the people who live in it.

Suggestive Questions

Where does the sun rise ?

Did you ever see the sun rise ?

Is it night anywhere now ?

Why ?

Where does the moon get her light ?

Where have you seen the new moon ?

Was it on the same side of the earth as the sun or on the opposite side ?

Of what use is the moon ?

Where does the sun set ?

Have you ever noticed the color of the clouds at sunset ?

What makes the color ? (Show a prism.)

Does all color come from light ?

Have you ever seen a rainbow ?

Can you find the colors of the rainbow in the clouds at sunset ?

Can you find these colors in the flowers ?

Who sends the rainbow and the beautiful clouds ?



SNOW-CRYSTALS ON THE TEACHER'S SLEEVE



In the year 1911, a great many boys and girls who are now at school will see in the sky at night a beautiful object different from the moon or stars. If you are living at that time, you must watch for it, and learn all you can about it.

Do not be in a hurry to satisfy a desire for information. Hunger is sometimes a hopeful sign.

PLANTS

“No beautiful palace have I on the hill
No pictures to hang in my halls,
But never a painter could match with his skill
The roses a-bloom on my walls.”

—*Emily H. Miller.*

When the buds begin to swell, usually, about the middle of March, let the children place twigs of horse chestnut, willow, apple, pear, cherry, and peach in neat jars or vases containing water. If the water is changed every few days, the leaves and blossoms will soon appear. Ask the children to make drawings or water-color paintings of the larger twigs and blossoms, as they appear. Let the children plant beans, corn, squashes, and morning-glories in boxes, or out of doors, as soon as danger of frost is past, and notice the manner of their growth. Be

sure that every thing is neat enough and clean enough to adorn a parlor. If well cared for the morning-glories will bloom in about six weeks from planting. Have some flowering plants growing in the windows. There is nothing better than geraniums and the pink oxalis. Ferns placed in vases or ordinary glass tumblers with a little of the leaf mold of the woods will last a long time. The sensitive plant, mimosa, is easily grown from the seed, and it will greatly interest children.

In the autumn months, leaves should be brought in and drawings made of the different forms. The leaves of the principal forest and shade trees should be identified and named.

Let pupils press twigs of the oak, maple, elm, etc., that have four or five leaves, paste them on card-board, and hang them on the walls. Make a collection of the principal kinds of grain in small glass bottles, label them, and occasionally place them where they can be seen and handled.

INSECTS

The prime purpose in the mind of the teacher should be character-building. We are to use nature study with that end in view. In the

early years of school life we should direct attention to the goodness and beauty in nature, so as to sweeten the life and enlarge the thought of the child. We should lead children to take an interest in insect life so that they will observe habits and mode of life. Call attention to the beauty of the butterfly, the industry and providence of the bee, the wisdom and strength of the ant, the ingenuity of the spider, and the song of the cricket and katy-did. Place crickets, grasshoppers or other insects in glass fruit-jars supplied with suitable food, and keep them about the school room for several days for study.

DIVISIONS OF TIME

During the first three years of school it is unnecessary to have set times and days for nature study. The study should be somewhat irregular. Aim at breadth rather than definite instruction.

In the spring study growing plants, flowers, the returning birds and insects. In the autumn give attention to leaves, deciduous trees, the late insect life, and the birds that are going away.

During winter the study of grains, evergreens, winter-birds, and familiar animals may be profitably pursued. Astronomy and meteorology should receive occasional attention all the year.

PART II

CHAPTER V

FOURTH, FIFTH, AND SIXTH YEARS

The subject should now be taken up in a more orderly and systematic way. Pupils should be taught how to study. Decide upon either one, two, three, or four periods a week of not more than twenty minutes each, according as you have time and can make necessary preparation. It will not interfere with other studies, but it will help them.

The first period in the morning is most convenient.

Have a definite purpose in mind at the beginning of each period.

Ask pupils to bring material to school; but have a supply of your own, thoughtfully selected, so that the object of the lesson may not be defeated. Use material provided by the children as far as it will answer the purpose.

Question so as to inspire thought.

Question so as to lead pupils to discover general laws and principles.

Question so as to leave pupils in a mood for more.

Give new words as needed by the individual to express ideas.

Discourage no one, and do not hurry.

Children improve by doing their best every day. You cannot expect more.

Do not call for oral recitations in review until a review has been written. When a topic has been completed, call for a written resumé. In this way, you will learn what each individual has thought out.

You will be surprised at the variety of thought and expression by members of the same class.

Oral recitations should be called for after the written lesson. If you have the oral review first, the slow ones will learn from the leaders by imitation. Remember that one of the objects of nature study is to make original investigators.

It is neither necessary nor always desirable to follow the order of topics here given; make your own selection. Begin with the one in which you take the most interest, and that will give you strength for another.

Have faith in yourself. Give very few, if any, directions about seed-planting. Let success come through experience. It does not come to a person in real life in any other way.

September is a very good time in which to begin the study of the whole plant and its parts, ending with a lesson on buds just before winter closes in. Seeds should also be planted early in the spring. Take up the study of buds again as they begin to open, and continue with the growing plants and flowers. Study birds and insects in their season, and deciduous trees when the leaves are on. Grain, stones, soil, ores, evergreens, and animals are the best material for winter study.

Each pupil should have a blank book in which to preserve pressed specimens of whole plants, leaves, flowers, drawings, and to record results of observation, and written reviews.

Have pupils learn and recite short selections from authors who are lovers of nature. Have at least one such recitation a week; one every morning is better. Bryant, Whittier, Longfellow, Wordsworth, Coleridge, and many good writers of the present time furnish abundant material.

CHAPTER VI

PLANT STUDY

Request each pupil to bring a whole plant to school. Have supplies of your own, but do not use them unless it is necessary. Weeds are as good as anything. Have some with stalks or stems, and some without.

Lead pupils by questions to point out the different parts of the plant, and to think out their uses. Call for the conditions in which the plant was growing and its relation to earth, air, water, heat and light.

Give four or five periods to the consideration of the process by which the earth is watered, the work of the sun, clouds, rain, snow, hail, frost, dew, and invisible vapor.

Keep in mind the difference between force and matter, and their office in the economy of nature. After you have completed the oral study of the whole plant, let each pupil press a whole plant. When it is dry, put a little mucilage on one side and paste it to the first page of the pupil's book. On the opposite page let the pupil place the first written lesson.

The questions given here are meant for suggestions only. You should frame your questions according to the power of your pupils and the line of thought you wish to bring out, and be guided to some extent by the answers you receive.

Suggestive Questions

- Where was your plant growing ?
- Was it in the shade or in the sun ?
- In what kind of ground was it ?
- Does it grow wild without help ?
- Can you name any of its parts ?
- What are the roots for ?
- What is the stem for ?
- Of what use are the leaves ?
- Have all plants stems ?
- Did you ever see a plant without leaves ?
- What do plants live on ?
- Do they require anything besides earth, air, and water ?
- Who waters the wild plants ?
- Where does rain come from ?
- What supplies the clouds with moisture ?
- Can you see vapor as it goes up to the clouds ?
- What makes it rise ?
- What carries the clouds from the ocean to the land ?
- What becomes of the rain which falls to the earth ?

Does it ever find its way back to the ocean ?

How high are the clouds ?

Describe some of the cloud-forms which you have seen.

How much rain falls on this region every year ?

What happens to those regions which have no rain ?

If pupils are not able to answer questions like those given, let them read an account of how the earth is watered, or tell it to them. Do not attempt to draw water out of a dry well.

Something like the following will do: "The sun shining on the land and water of the earth's surface changes some of the water to invisible vapor. It rises until it reaches the cold, upper air, where it is changed to clouds. These clouds are borne over the land by the winds. When the clouds come in contact with colder bodies of air or cold mountain-tops, they are changed to drops of water which fall to the earth as rain.

"Some of the rain helps to nourish plants and animals, some of it sinks into the ground, and some finds its way through streams and rivers back to the ocean again."

Do plants ever lose their leaves ?

Do all plants shed their leaves ?

What are those trees called which drop their leaves in autumn ?

Do trees grow when their leaves are off ?

What trees retain their leaves during winter ?

Write what you know about a plant, its parts and their uses.

Write an account of the way the earth is watered.

What do you know about the use of plants ?

From what plants do we obtain food ? clothing ? medicine ?

What plants are hurtful ?

Write what you know about the uses of plants.

Outline

Give to the whole plant from ten to twenty lessons.

Root
 Stem
 Leaves
 Their uses
 Earth, air, water, light, and heat
 Deciduous and evergreen plants
 Uses of plants
 Let pupils talk freely about home plants and experiences.
 Press and preserve a whole plant.
 Let pupils write what they know about it.

ROOTS

Ask pupils to bring in specimens of roots. You should have a beet, a potato, a parsnip, a lily bulb, a wild plantain, and the roots of a little tree.

Question so as to bring to the attention the different forms and uses of roots. After a sufficient amount of study cut sheets of drawing paper to the size of the children's blank books. Have at least four different root-forms drawn by pupils on one side of the paper and then paste it into the blank book. Ask for a written resumé and have it placed on the next page.

Outline

Roots Five to ten lessons	Types	Uses	woody
			thread-like
			round
			cone-shaped
			scales
		Make and preserve drawings.	
		Write results of observation.	

STEMS, STALK, TRUNK

Have pupils plant corn, beans, peas, and morning-glories, apple-seed, flax, and wheat. Let pupils collect material as before.

You will need a little tree, a corn-stalk, a wheat or oat stalk, a piece of a grape vine showing the tendrils; a morning-glory, and a piece of hop vine, each twined around its support.

Question so as to lead pupils to observe forms and manner of growth, and to think out functions and uses. Make and preserve drawings, and have written and oral review as before.

Suggestive Questions

What is the stem for ?

Cut the stem slanting, and see how it looks inside.

What do you see in the wood-stem ?

Count the rings. What do they tell you ?

Where is the soft part of the wood-stem, inside or outside ?

Which is the newer ?

Where is the oldest part of the wood ?

How does the trunk of a tree increase in size ?

Why is the bark of an old tree rough, while that of a young tree is smooth ?

What does the grain of boards mean ?

How does the corn-stalk look on the inside ?

Which is the harder, the outside or the inside ?

How does it increase in size ?

Do you know about any trees that look like the corn stalk on the inside. *Answer, palms.*

How does the grape vine hold itself up?

Do you know of any other plants that hold themselves up in this way?

What does the morning-glory do?

Which way does it twine around the support?

Do all morning-glories go the same way?

Which way does the hop vine go?

Outline

Stem, stalk or trunk	}	Uses of the plant	} What for?
		Wood	
		Twining	
		Clinging	
		Tendrils	
		Hairy stems	
		Prickly stems	
		Jointed stems	
		Hollow stems	
		Outside growers	
		Inside growers	
		Uses to us	
		Make drawings	
		Written review	
Oral review			

LEAVES

Study the arrangement of leaves on the stem.

Study, press, and preserve examples of the principal leaf forms; whole edge, notched edge, lobed, simple, compound, needle-shaped.

Venation, — parallel, netted, hand-veined, feather-veined.

Identify, press, paste in blank book, and name twigs containing leaves of the principal forest and shade trees,—oak, maple, beech, ash, elm, birch, cherry, walnut, chestnut, apple, peach, pear, plum, pine, cedar, hemlock, spruce, balsam. Do not study more than two kinds of leaves in a study period.

Suggestive Questions on Corn and the Bean

How long did it take the corn to come up?
The bean?

How many leaves had the corn as it came out of the ground?

How many had the bean?

Is the corn an outside grower, or an inside grower?

How are the corn leaves veined?

State three things that you know about the corn plant.

Are the forest trees outside growers or inside growers?

How do you know ?

How are their leaves veined, parallel or netted ?

How many leaves has the little maple when it comes up ?

The little elm ? The apple ?

What two things do you know about the leaves of outside growers ?

How many leaves had our bean as it came out of the ground ?

How are the leaves veined ?

What else can you tell about the bean ?

Have pupils make one or two pages of drawings of leaves, and write a story about leaves. These should be placed in their books.

Leaves	Arrangement
Ten to twenty lessons	Whole edge
	Notched
	Lobed
	Simple
	Compound
	Venation
	Read good selections.
	Recite good selections.
	Draw.
	Oral review
	Written review

BUDS

Plant study should be closed late in the autumn or early winter by a few lessons on buds. The pupils have already noticed the position of buds in the axil of the leaf or at the end of the branch, and that the buds sometimes remain after the leaves have fallen. Procure twigs of horse-chestnut, lilac, peach, cherry, and some annual that has no buds. The pupils will readily see that some plants prepare to grow again, while others do not; the terms annual and perennial may be given.

Borrow some magnifying glasses; direct pupils to cut the buds length-wise and tell what they see. They may see, if they have trained eyes and good glasses, that some buds contain leaves, some flowers, and some both leaves and flowers; and that the little leaves and blossoms are carefully protected from cold and rain by various devices. If they do not detect all that is in the bud, say nothing, but wait till March; then place the same kinds of twigs in water, and study the buds as they open.

NATURAL DISTRIBUTION OF SEEDS

Procure seeds of the elm, maple, and dande-

lion in the spring, and burs, stick-me-tights, and thistles in the autumn. Lead pupils to see what the wings and spears are for, and to think out why it is best for the seed to seek a new place in which to grow.

SEED PLANTING

As a rule distribute seeds that will lead pupils to discover general laws and principles; outside and inside growers; venation of leaves; manner of growth; adaptation to soil and climate.

Call attention to the starch stored in the seed and how it is changed to sugar to feed the growing plant. This may be illustrated by placing some barley on a moistened sponge or blotting paper for a few days till it sprouts. Dry the sprouted barley, and test the sprouted and un-sprouted grain by the taste.

Why is food stored up in the seed as starch, and not sugar ?

Why are some seeds used as food ?

What seeds care for themselves ?

What seeds need our care ?

Distribute at first large seeds or those which will be likely to grow under a child's care. Morning-glories, sweet peas, and nasturtiums are suit-

able for window-gardens at home and at school; while asters, pansies, dianthus, and double hollyhocks are likely to prove satisfactory for home planting out of doors. Wheat, corn, rye, oats, barley, buckwheat, flax, beans, peas, and squashes should also be distributed for school and home planting. If possible distribute also some hardy bulbs for home planting, such as the tulip, crocus, and gladiolus. Hyacinths may be successfully grown at school.

Some Friday afternoon in September have a flower show in in your school-room, at which should be exhibited all the best flowers and plants grown by teacher and pupils during the summer, and experiences interchanged.

CHAPTER VII

STONES AND SOIL

Every one ought to know at sight the four great kinds of underlying rock: granite, sandstone, limestone, and shale; and something about their relation to natural scenery and the soil. For farming purposes soil formed from granite or sandstone is poor; that formed from limestone and most shale is good.

A granite region is rugged and wild, as the Adirondacks. Layers of limestone or sandstone over shale produce waterfalls. Shale soon disintegrates and produces a deep, rich soil.

Limestone is distinguished by its bluish gray color. A simple test is strong vinegar or dilute acid: if limestone it will effervesce; if granite or sandstone it will not.

Sandstone may be recognized by its gritty character. It is usually white, gray, red, brown, or banded.

Granite has a mottled appearance; and it is either red or gray. It is very hard and will

often scratch glass. Shale is flaky and easily broken.

Sandstone is powdered quartz or granite, re-hardened into rock. The color is usually due to iron.

Granite is generally composed of three minerals; *quartz*, the ore of gold, a hard, white, substance of nearly the same composition as glass; *feldspar*, a white or flesh colored rock from which porcelain is made; and either *mica* or *hornblende*. Mica is a scaly substance used for stove windows; hornblende forms in black, thread-like crystals.

If a granite is formed of quartz, feldspar, and mica, it is called true granite. If it is formed of quartz, feldspar, and hornblende, it is called syenite.

You should have a cabinet of rock specimens, labelled. If you cannot prepare them yourself there is always some one in the neighborhood who will be glad to do it for you.

When pupils bring to school pieces of rock or stones, send them to the cabinet to identify them.

Suggestive Questions

Have you ever seen a ledge of rock ? Where ?

Was the rock in layers ?

Was this stone ever part of a ledge ?

Why is this stone smooth and that one rough and jagged ?

Why are smooth stones generally found south of the ledge to which they belonged ?

Can you label this stone ?

Stones	{	Granite	{	quartz feldspar mica or horn- blende	}	no fossils
		Sandstone	{	white, gray, red, banded often contains imprints of plants and animals.	}	
		Limestone	{	bluish gray generally contains im- prints of plants and ani- mals.	}	
		Shale	{	limestone and clay contains vegetable matter.	}	

SOIL

Soil in general is pulverized rock mixed with vegetable or animal matter or both.

Sand is pulverized quartz or granite.

Clay is decomposed feldspar.

Loam is sand and clay mixed with vegetable matter, or decomposed limestone or shale.

Sand is generally light in color, and it is always gritty.

Clay feels like flour between the fingers.

Loam generally has some grit, and is dark colored. If black or dark brown it contains vegetable matter; if light brown or red it contains iron.

Iron is the universal earth painter.

You should have at least three clear bottles filled with the three great kinds of earth.

Coarse sand or gravel has been deposited by swift water or ice; fine sand or loam by still water; usually a lake, bay, or quiet river.

Soil {
 Sand
 Clay
 Loam
 Gravel

CHAPTER VIII

BIRDS, BEASTS, AND INSECTS

BIRDS

Divide your class into groups of five to ten. Assign to each group a bird, such as the robin, bluebird, English sparrow, song sparrow, oriole, bob-o-link, black bird, crow, dove, turkey, hen, goose, duck, etc.

Let it be understood that at future times specified each group will be prepared to make a drawing, and tell something about the appearance, habits, and mode of life of the bird assigned. It will be necessary to give the members of your class a card containing a few questions to guide them in their study, like the following:

When does the robin * return ?

Where does it build its nest ?

What material does it use ?

How many eggs does it lay ? Describe them.

How long does the mother sit to hatch them ?

* Use the name of the bird to be studied.

How long do the young robins remain in the nest ?

Which robin sings, the male or the female ?

Is there any difference in the appearance of these two ?

Does the male bird feed the young ?

How many times a day does the robin feed her young ?

What does she feed them ?

What good does the robin do ?

Does it do any any harm ?

Does the robin ever change its color ?

These questions are not to be answered when given, but to be used to guide the pupil in his study for two or three months. The object is not to learn a little about a great many birds, but to learn how to study.

For winter study stuffed specimens may be borrowed and drawings made of the head, feet, and beak, and descriptions given. Place all finished drawings and written reviews in the blank book. Read "Bird Life" by Frank M. Chapman.

Suggestive Questions

Why do some birds migrate ?

Why does the robin stay later in autumn and earlier in spring than the bob-o-link ?

What bird does not build a nest, but lays an egg in the nest of another bird ?

DOMESTIC AND FAMILIAR WILD ANIMALS

Animals may be studied in the same way as the birds. Assign subjects to divisions of the class and give questions to guide observation. Make drawings of head, teeth, feet, etc. Study habits, mode of life, and uses.

INSECTS

Select a few from several different families that are likely to prove interesting, such as the butterfly, moth, ant, spider, grasshopper. Divide the class into groups, or let the whole class study one insect at a time. Give guiding questions. A child who has studied two or three insects in the right way during his school life is better equipped than one who has desultory information about a great many.

Suggestive Questions

MOTHS AND BUTTERFLIES

1. Did you ever see a butterfly ?
2. Are all butterflies the same size ?
3. Are all butterflies the same color ?

4. Did you ever see a blue butterfly ?
5. Was it small or large ?
6. When do you see butterflies, at night or in the day time ?
7. How many feet have butterflies ?
8. Do all butterflies use all their feet for walking ?
9. Did you ever see a butterfly which used only four feet for walking ?
10. With what do a butterfly's wings appear to be covered ?
11. What other insects besides the butterfly have this dust or powder on the wings ?
12. How do a butterfly's or a moth's wings appear after this dust or powder is removed ?
13. Did you ever see this dust under a microscope or magnifying glass ?
14. What does it appear to be ?
15. What do we call the dust on the wings ?
16. How many wings have butterflies and moths ?
17. How do butterflies hold their wings when at rest ?
18. When at rest, how do moths hold their wings ?

19. When do moths fly, at night or in the day time ?

20. Did you ever see a moth fly in the day time ?

CATERPILLARS

21. Did you ever see a caterpillar ?

22. How many feet has a caterpillar ?

23. Are all caterpillars hairy ?

24. From what does a caterpillar hatch ?

25. What do caterpillars eat ?

26. Do all caterpillars eat the same kind of leaves ?

27. Do larva change their color ? (Do not call them worms; call them larva.)

28. Do caterpillars ever change their skin ?

29. Into what does a caterpillar turn ? (This answer will probably be "a butterfly"; it should be "a chrysalis" or "a pupa".)

30. Does the larva of a butterfly make a cocoon ?

31. What are cocoons made of ?

32. Where do some larva go to change into a chrysalis ?

33. When a butterfly or moth first emerges from the cocoon are the wings large or small ?

34. Do the wings grow rapidly or slowly ?

35. What will happen to a butterfly or moth, if it hatches in a small box, or in some place where it cannot crawl up and allow the wings to hang down ?

36. How do butterflies or moths take their food ?

37. Can all moths eat ?

38. Did you ever see the eggs of a butterfly or a moth ?

39. Where are the eggs usually placed ?

40. Can butterflies and moths eat solid food ?

41. Does a butterfly have any teeth ?

42. How does the larva of a butterfly fasten itself when it is going to change to a chrysalis ?

43. Do butterflies and moths do any good ?

44. What harm is done by butterflies and moths ?

45. Did you ever see a butterfly or moth change to a chrysalis ?

46. How does a butterfly differ from a moth ?

BEES AND WASPS

47. Did you ever see a bee ? A wasp ?

48. How many wings have bees and wasps ?

49. How many feet ?

50. What do bees eat ?

51. Do bees and wasps eat anything besides honey ?

52. Do any of the bees or wasps eat insects ?

53. Did you ever see a mud wasp get into a spider's web ?

54. What did it do ?

55. Did the spider kill it ?

56. Did you ever see a nest of a mud wasp ?

57. What is the nest made of, and what is inside of the nest ? Anything besides young wasps ?

58. Did you ever see a hornet's nest ?

59. Of what does a hornet's nest appear to be made ?

60. Where do the hornets get the material to make the nest ?

61. Did you ever see hornets building their nests ?

ANTS

62. Did you ever see an ants' nest ?

63. How many kinds of ants' have you seen ?

64. Did you ever see an ants' nest in which there were small red ones and large black ones ?

65. Which ants own the nest, the small red ones or the large black ones ?

66. Are the small red ants the young of the large black ones ?

67. Are ants useful ?

68. What do ants do ?

69. Do ants ever have wings ?

BEETLES

70. Did you ever see a beetle ?

71. Do beetles have wings ?

72. How many wings have beetles ?

73. Are the upper and under wings of a beetle alike ?

74. Do beetles have teeth ?

75. Did you ever see the teeth of a beetle ?

76. How many feet have beetles ?

77. Do all insects have the same number of feet ?

78. Do beetles do any harm ?

79. Do they do any good ?

80. Are beetles all the same color ?

FLIES

81. How many wings has a fly ?

82. Are the veins of a fly's wing like those of a bee's wing ?

83. Do flies have teeth like the beetles' ? (If a microscope can not be had, get a good magnifying glass.)

84. Did you ever see the large round knots on the golden-rod ?

85. Did you ever cut one of these knots open ?
What did you find in it ?

86. If you keep these knots what will hatch out of them ?

87. Did you ever see round balls on the oak trees ?

88. Did you ever examine the inside of them ?

89. Did you find anything in them ? What was it ?

90. If you place these balls in a glass can, will anything hatch out of them ?

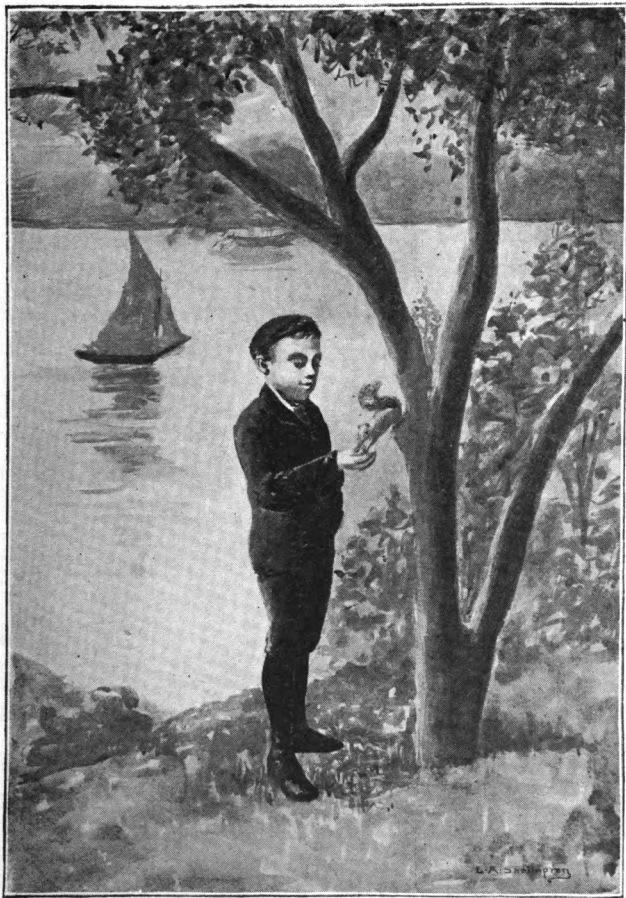
CHAPTER IX

COLLECTIONS

Making and caring for collections are important elements in nature study. It is better to have ten specimens, neatly and accurately labelled, and well kept, than to have a thousand in a heterogeneous mass. Large, haphazard collections become dirty, tiresome, and confusing.

When children become interested in making a collection of rocks and fossils, instruct them to break the rock specimens with a hammer into neat oblong blocks about two by three inches, one inch thick. They should take to the field, besides a hammer and chisel, a newspaper, and when a specimen is secured, wrap it up so that it will not be soiled or scratched.

Ask the boys to make some smooth wooden blocks, three inches square, an inch thick, slanting on one edge. Glue the specimen to the top of the block, and a label on the slanting edge of the block showing the name of the specimen, the locality where found, and the name of the owner.



MAKING FRIENDS OF ANIMALS

Read,—“The Earth and its Story,” by Heilprin. Directions have already been given for pressing and preserving plants in pupils’ blank books. If a more extensive collection is desired it may be made in the following manner: Procure two smooth boards, about ten by twelve inches, an inch thick. Cut sheets of blotting paper to the size of these boards. Get four iron quilting-frame clamps, one for each corner, and you have a very good improvised press. When the specimens are dry, paste them on sheets of ordinary drawing paper cut to the desired size. These sheets should be labelled, and may be bound into book form by piercing two holes through one side, and tying loosely with ribbon.

Botanical specimens should either be bound or kept in drawers or boxes away from dust and light.

Young children should not be encouraged to make collections from the animal kingdom. Collecting eggs leads to robbing birds’ nests. Collecting insects has an element of cruelty; and besides, such a collection is difficult to keep in good condition. Wait till the character is well formed before undertaking these things.

