FORT HAYS
KANSAS NORMAL SCHOOL
HAYS, KANSAS

NATURE STUDY
BULLETIN

Prepared by
LYMAN D. WOOSTER
Department of Biology

KANSAS STATE PRINTING PLANT.
W. R. SMITH, State Printer.
TOPEKA. 1917.
7-821
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The Purpose of this Bulletin.

This bulletin has been prepared for the sake of boys and girls through the sympathetic interest of their teachers. It is intended as a suggestive help in the attempt to make education fit childhood's instinctive desire to be educated; not from adulthood's viewpoint, but from childhood's.

The educational term recognized by thoughtful educators as covering the above attitude is "nature study." To this subject, and through it to the boys and girls, this bulletin is dedicated.

The desire has been to make the contents of this bulletin as specific as its size would permit. Necessarily its contents must be largely suggestive rather than informational.

The Department of Biology of the Fort Hays Kansas Normal School always stands ready to help in every way possible. It welcomes letters of inquiry. It will gladly try to identify and name weeds, weed seed, tree leaves, insects and other items of nature interest which may be sent in. Do not hesitate to write.

It is our desire to help get nature study started in every school within our reach. Give us the opportunity.
Good Morning!

Good morning, friend teacher! Have you used nature study? Have you called the attention of the boys and girls to anything of interest in the great outdoors lately? A new bird? An eclipse of the moon? A snowflake? (And, by the way, how many points, or main divisions, has a snowflake? Or do they all have the same number?)

Can the boys and girls find the North Star? The Big Dipper? The Little Dipper? Do they know what the bright star in the evening heavens is? Do you?

Have they found the little, shiny black seeds of the pigweed (red root)? Have they seen why a cocklebur can hang on so tenaciously? Have they dropped a dry box-elder seed from a height and seen how it fell? Have you?

Can they recognize the trees by their leaves? or twigs? or bark? Can you?

All these things, and many more, can become part of their fund of knowledge, which their senses are intended to be gathering (and which perhaps yours missed, when you were a youngster, because your teacher did not call your attention to them, though your brain at that time had a special aptitude and appetite for those things).

Are the children in your school to go without these things because their teacher did not call their attention to them?

You don't know enough about these things yourself to help the children? Never mind that. Call attention to them anyhow. Set things going. The children can find them out if you can't. And they are the ones to do it, anyhow. You are just a guide, an assistant to their learning, you know. It's a good thing you don't know—you'd go right and tell. Then all the fun of hunting for it, of solving a problem, would be spoiled. Just because you are so much bigger than they you have no right to spoil all the fun of learning! Shame on you. Pick on some one your size. Give them a fair chance. (If you really want to find out some of these things there are ways of doing it. But it is n't our plan just now to discuss that point.)

We merely wish to urge that you adjust your school work to the "nature study way," for your own sake as well as that of the boys and girls. We have seen the entire spirit of a schoolroom changed and the efficiency of the "regular" studies doubled by the refreshing effect of such a readjustment of school work.

Remember that it is n't nature study that does it; it is a way of doing things for which the term nature study is merely a convenient bit of educational nomenclature.

Well, good morning! Pardon the intrusion.
I. The Meaning and Purpose of Nature Study.


Boys and girls all pass through a period of years when their chief interests lie in living things and the natural objects of the world about them. From the very beginning of infancy the child gradually begins to absorb, through his senses, the great mass of information which becomes the basis for all his future education. Every atom of his knowledge comes through these senses. Keen eyesight and keen insight are more nearly synonymous than one, at first thought, might believe.

This continues his dominant attitude through the first dozen or so years of his life. Never again does he observe so keenly nor so justly as through these years. You and I are not half as keen in our observation nor half as accurate in our judgment as he is.

The attempt to supply this, nature's way of educating, and to develop it, has been termed "nature study." It is not a new subject to be added to an already crowded curriculum; but rather a point of attack, or an attitude of mind, if you please. It is an attempt to gain first-hand knowledge of the world in which we live rather than second-hand knowledge about it; to find out for ourselves rather than to read what others say they have discovered.

Reading, writing and arithmetic are invaluable tools which aid us in our search after and our use of knowledge, but they are merely means to an end. In too many cases we have made the book or the mathematical problem an end in itself. It is only a means to an end.

The beautiful poem is not beautiful for its own sake, but because it is the simple, accurate and attractive expression of some great reality. It is a tool well used.

Nature study is simply a study of nature as we find it about us every day, and so abundantly that we never are able to know all its wonderful workings and laws, and yet upon its laws is based life itself.

Fortunate are we if we learn to read the book of this great out of doors. It is the beginning of knowledge and the ending; it is the earth and all that's in it, and life.

2. The Purpose of Nature Study.

Childhood's instinctive though largely unconscious purpose is to see, hear, taste, smell and feel the world about it—it just wants to know, and that's all. The teacher's purpose and function is to unobtrusively guide childhood's instincts more efficiently.

The term "nature study" designates a spirit, not a thing; an attitude, not a course of study. It need not even be taken literally as a study of nature, but rather a term of educational significance, having reference to the attempt to make education fit.

But, secondarily, there are a number of results which should come from nature study. A keen sense of proportion, a discriminating sense of values, an open and just mind, a kind and sympathetic attitude toward life and living things, an unprejudiced view of truth, a clear-cut imagination, a sense of the beautiful, and a high appreciation of the fundamental virtues are final products of the constant contact with nature through keenly trained senses.

Then to the teacher, because of all the above-mentioned things, there comes less necessity for thought about discipline and more joy and genuine interest in her school work.

Nature study should be a clarifier of our educational vision; it should correct our perspective and clear away the accumulated cobwebs of artificiality.

When boys and girls start to school they may have the edge of an expectant mental appetite dulled and deadened by unnatural and undesired mental food, or they may have it sharpened and quickened and be left hungering for more.
3. The Spirit of Nature Study.

Teachers sometimes say, "I would like to use nature study in my school, but I don't know enough about birds and flowers and trees myself to teach about them." In fact, this is apparently the biggest bugaboo to the teacher in starting nature study.

As a matter of fact, that very condition provides the best sort of a setting for nature-study work, for the less the teacher knows about a subject the less likely she is to tell the children everything and the more likely the children are to gain the tremendous advantage of finding out for themselves. Nature study seeks first-hand knowledge, not second-hand.

One of the best things that can ever happen to a schoolroom is for the teacher to come to the point where she frankly says, in effect: "Children, I may not know any more about this than you do, but let's find out all we can together." From that moment the teacher is no longer a know-it-all, set up on a throne, which is wobbly, to say the least; but she immediately becomes a comrade, a learner with the pupils, but yet their leader. She loses nothing of their respect, but rather gains the more. And so nature study can be and is a purifier of our attitude toward our teaching. We do not need to be afraid to say, "I don't know," but we need to be sure to add to it, "Let's find out," and then make a good search, all together. That is the spirit of nature study.

The teacher needs to find a sympathetic bond between herself and every boy and girl in her school, but most of all between herself and the boy who causes trouble. The boy needs to find out that the teacher is really interested in the things in which he is interested. Nature is of universal interest and furnishes that bond.

Adjust your school work to what we have been pleased to call "the nature study way." It will be refreshed and simplified. It will help to obliterate the nerve-racking strain which arises from the artificiality and bookishness of our teaching and the consequent lack of sympathetic understanding between teacher and pupil.
4. Nature Study Should Lead To—

1. A spirit of comradeship between teacher and pupils, and a better consequent school spirit.
2. A vitalized interest in school work, and consequently more real accomplishment and less time wasted in artificial attempts to arouse interest and maintain the same.
3. Less need of discipline, because childhood interests and energies are occupied and because of the more sympathetic bond between teacher and pupil.

AND THEN FINALLY, IN LATER YEARS, TO—

1. A knowledge of the simple facts and processes of nature and of the things about us with which we must deal all our lives.
2. A better understanding of nature's ways and phenomena and less fear of the same.
3. A clearer discernment of truth and less mystery, superstition and prejudice.
4. A well-developed imagination, constantly kept in balance by truth.
5. Better health of body and mind through a better understanding of the certainty of the working of nature's laws.

5. What Educators Say.

Nature study is the fundamental subject matter of education. Elementary education which does not include nature study is not true elementary education.—Dr. G. Stanley Hall.

The training of the senses should always have been a primary object in human education at every stage from primary to professional.—Dr. Charles W. Eliot.

The best part of all human knowledge has come by exact and studied observation made through the senses of sight, hearing, taste, smell and touch.—Dr. Charles W. Eliot.

Knowledge gained at second hand from books or hearsay is infinitely inferior in quality to knowledge gained at first hand by direct observation and experiment with nature.—Huxley.

It is the commonest misapprehension to confuse information about natural objects with first-hand observation and study.

Nature study in the ideal school will have a central place, slowly subordinating most other branches as formal and accessory, while it remains substantial.—Dr. G. Stanley Hall.

Nature study is an attitude of mind. It concerns itself with the child's outlook on the world. Nature study will endure because it is natural and of universal application.—L. H. Bailey (Cornell University).

I have a growing feeling that the nature-study method is not only a public-school process, but that it is equally needed in colleges and universities for all unspecialized students.—L. H. Bailey.

Lead your child out into Nature,
Tutor him on the hilltop and in the valley,
There will he listen better, and in the sense of freedom
will give him more strength to overcome difficulties.—Pestalozzi.
6. How To Begin.

1. In the first place, begin!

2. The habit of incidentally calling attention to things of interest in nature, and encouraging the children to do the same, is the beginning, and in many ways the best form of nature study. The informality and naturalness of this habit is commendable. (Children are directed too much.) Any teacher can do this much, no matter how ignorant of such things she feels herself to be.

3. After you have tried the above for awhile it will become natural to set aside five or ten minutes each day, or at least twice a week—say following the noon hour—for the above reports and discussions.

4. Keep a diary of events in nature, especially during the spring; for example, the coming of each kind of bird, the first flowers, the late frosts.

5. Plan at least one definite project for each season, as weed-seed collecting in the autumn, the study of the shadow stick in the winter, and the making of wren houses in the spring.

6. The mere fact that an aquarium or any other source of nature interest is in the schoolroom, even though little is ever said about it, is no small consideration. It is worth while.

7. The only way to start is to start. The only way to begin is to begin. Begin!
II. Nature Study by Seasons.

Each season lends itself particularly to certain studies. The following suggestions briefly indicate the items adaptable, respectively, to autumn, winter and spring. Each topic is more fully discussed elsewhere in this bulletin.

Itemized outlines for study for each season—first, by topics, and second, by grades—are also given elsewhere in this bulletin.

1. Brief Outline by Seasons.

NATURE STUDY FOR AUTUMN.

The following can be used for study better in the autumn than at any other time of the school year: Weeds, fungi, fruits, and seed vessels, weed seeds, tree leaves, crop seeds, insects, turtles, snakes, insect work.

The following can also be studied in the autumn: Birds, fishes, minerals, flowers (especially composite flowers).

Autumn is particularly the time to collect weed seeds. We recommend this as the paramount nature-study item for autumn. It is also the best time to have an aquarium. It is a good season for excursions.

NATURE STUDY FOR WINTER.

Winter is the best time for the study of weather, stars, minerals, kinds of wood, the grain of wood, winter birds, pets, bark and twigs of trees, snow, frost, ice, and evergreens.

Especially we recommend, for winter, the use of the shadow stick.

Begin, in the lower grades especially, the making of bird houses. In the upper grades these bird houses can be made in early spring.

It is the best time to study stars, because they can be seen early in the evening, because the nights are darkest, and because the brightest of the constellations appear in winter.

It is the best time to learn to recognize trees by their bark and twigs, because the leaves are absent.

There are plenty of nature items for study in the winter.

NATURE STUDY FOR SPRING.

Prepare for Arbor and Bird Day, which should occur sometime during the first half of April.

Make wren houses.

Keep a nature diary—a record of the appearance of birds, tree leaves, flowers, and all the other numerous “first appearances” of the season. This is the best of observation habit-formers.

Keep a special bird record—on the blackboard if possible. It can show when each bird was first seen, by whom, and when each child in the room first saw each bird, or as much of the above as the teacher thinks best, or any modification of it.

Watch particularly for the shade-tree flowers. Most people do not know that the trees have blossoms.

Items for study in the spring are too numerous and obvious to mention further here.
<table>
<thead>
<tr>
<th>AUTUMN</th>
<th>BIRDS</th>
<th>INSECTS</th>
<th>ANIMALS IN GENERAL</th>
<th>TREES, SHRUBS AND VINES</th>
<th>PLANTS IN GENERAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognition of birds.</td>
<td>This is the best time for insect study.</td>
<td>Observe: Ground squirrels, gophers, prairie dogs, rabbits, turtles, frogs, salamanders, fishes, toads, crayfishes, snakes. Names of snakes: poisonous and harmless. Have an aquarium, if only a glass jar.</td>
<td>Learn to recognize trees by the leaves. Find poison ivy and learn to recognize it. Find tree diseases. Collect tree seeds. Find insect galls on tree leaves and twigs.</td>
<td>The best time to learn to recognize plants and plant families. Name parts of flowers. Composite flowers. Collect weed seed, crop seeds, and seed vessels. Study an apple, mushrooms, fungi, algae, bacteria, molds, yeast, mosses, ferns.</td>
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<td>WINTER</td>
<td>Study of housefly and mosquito. Examine with a magnifier. Collect insect work, such as galls, wood boring, etc. Where are the insects in winter?</td>
<td>Observe pets and domestic animals, cats, dogs, chickens, horses, cattle, pigs, rabbits, etc. Where do the following spend the winter: Toads? Frogs? Ground squirrels? Snakes? Turtles? Fishes? What do the rabbits eat in winter?</td>
<td>Learn to recognize trees by twigs, by bark. Observe winter buds. What trees have alternate and what trees have opposite buds? Gather wood samples. Name the evergreens as you see them. Mistletoe and holly.</td>
<td>Underground food storage in stems, roots and bulbs. Fruits: Apple, etc. Cut an apple in two. Which way do the seeds point, etc. House plants. Germinate seeds of various kinds. What ones come up with two seed leaves, and which with only one?</td>
<td></td>
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<tr>
<td>SPRING</td>
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<tr>
<td>WEATHER, STARS, MINERALS, ETC.</td>
<td>THINGS TO MAKE.</td>
<td>EXCURSIONS.</td>
<td>COLLECTIONS.</td>
<td>SPECIAL DAYS.</td>
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<tr>
<td><strong>AUTUMN.</strong></td>
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<tr>
<td><strong>SPRING.</strong></td>
<td>Lengthening days. Use shadow stick. Where is Orion at this season? Rainy spring days. Watch the animals on such days. What are lightning and thunder?</td>
<td>Keep a daily nature diary. Keep a record of the return of birds and of nest building. Put up bird houses about the middle of April. Make ant hill by putting earth and ants in a glass jar.</td>
<td>To observe birds. To stream or pond to find materials for aquarium. Watch the dragon flies. To observe and name spring flowers.</td>
<td>Vegetable seeds. Flower seeds.</td>
<td>March, April, May. Easter. Arbor and Bird Day. Circus in town.</td>
</tr>
</tbody>
</table>
# Nature Study Outline by Grades and by Seasons

The following outline is to be used as a suggestive help and not as a fixed form to be followed verbatim. It is concise rather than complete. It is a convenience—a thing to be used rather than followed.

<table>
<thead>
<tr>
<th>Approximate characteristics of child development</th>
<th>GRADE I.</th>
<th>GRADE II.</th>
<th>GRADE III.</th>
<th>GRADE IV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is important here as elsewhere to answer children’s many questions and to call attention to things of interest in nature as birds, flowers, insects, weather. Collect autumn leaves (avoid poison ivy).</td>
<td></td>
<td></td>
<td>Study house fly and mosquito. Why harmful? Study evergreens, holly and mistletoe before Christmas. Find Orion. Tell the story. Germinate some seeds late in the winter.</td>
<td>Continue shadow-stick observations. Learn to recognize trees by twigs and bark. Make a collection of kinds of wood. Study grain of wood. Keep a magnifying glass in the schoolroom.</td>
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<tr>
<td>Keep in the schoolroom, in all grades, things of interest; an aquarium, house plants, collections, etc. Connect stories with nature. Observe snowflakes.</td>
<td></td>
<td>Where do the birds go in winter? Other animals? Find North Star and the Big Dipper and Little Dipper. Keep a magnet in the schoolroom for the children to play with.</td>
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<tr>
<td>Encourage children to report things of interest in nature as seen or heard (this applies to all grades). Watch for return of robins, early flowers, tree buds and leaves.</td>
<td></td>
<td>Watch for the coming of the birds. Learn to recognize several birds, also wild flowers. Study apple blossoms. Observe butterflies.</td>
<td>Make wren houses. Observe Arbor and Bird Day. Watch for butterflies and moths to come out of chrysalises and cocoons. Keep a record of the return of the birds.</td>
<td>Keep a spring nature diary. Learn the names of parts of flowers. Study tulips, violets, etc. Record the nesting of the birds.</td>
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</tbody>
</table>
### NATURE STUDY OUTLINE BY GRADES AND BY SEASONS—Concluded.

<table>
<thead>
<tr>
<th>GRADE V.</th>
<th>GRADE VI.</th>
<th>GRADE VII.</th>
<th>GRADE VIII.</th>
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</thead>
<tbody>
<tr>
<td><strong>APPROXIMATE CHARACTERISTICS OF CHILD DEVELOPMENT.</strong></td>
<td><strong>What do the birds eat? What ones do the most good?</strong></td>
<td><strong>What do the birds eat? What ones do the most good?</strong></td>
<td><strong>What do the birds eat? What ones do the most good?</strong></td>
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<tr>
<td><strong>AUTUMN.</strong></td>
<td><strong>Start an ant hill in a jar.</strong></td>
<td><strong>Learn to recognize plants by families and by common names.</strong></td>
<td><strong>Classify animals. Classes of vertebrates; of invertebrates.</strong></td>
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<td></td>
<td><strong>Observe turtles, frogs, etc.</strong></td>
<td><strong>Gather weed seeds and name them.</strong></td>
<td><strong>Social animals; bees, ants, wasps.</strong></td>
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<td></td>
<td><strong>Collect weather record.</strong></td>
<td><strong>What weeds are particularly harmful?</strong></td>
<td><strong>Protective coloration and resemblance.</strong></td>
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<td></td>
<td><strong>Collect weed seeds.</strong></td>
<td><strong>Why?</strong></td>
<td><strong>Survival of the fittest.</strong></td>
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<td><strong>Life cycles of insects.</strong></td>
<td><strong>Harmful and helpful insects?</strong></td>
<td><strong>Plant and animal history.</strong></td>
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<td><strong>Structure of insects; number of legs, wings, etc.</strong></td>
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<td></td>
<td><strong>Eight or ten chief groups (orders) of insects.</strong></td>
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<td><strong>Find insect galls and other insect work.</strong></td>
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<td></td>
<td><strong>Continued weather record.</strong></td>
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<td><strong>Study coal and collect minerals.</strong></td>
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<td><strong>Study a snowflake. Number of points?</strong></td>
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<td><strong>Winter buds of trees.</strong></td>
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<td></td>
<td><strong>Morning and evening stars. (see an almanac).</strong></td>
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<td><strong>WINTER.</strong></td>
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<td></td>
<td><strong>Learn to recognize a few constellations.</strong></td>
<td><strong>Gather samples of soil, and display in bottles.</strong></td>
<td><strong>Bacteria, yeasts and molds.</strong></td>
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<td><strong>Study planets, size, distance, motions.</strong></td>
<td><strong>Study kinds of stones and minerals.</strong></td>
<td><strong>Algae, mosses and ferns.</strong></td>
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<td></td>
<td><strong>Watch almanac for eclipses.</strong></td>
<td><strong>Magnetism and electricity.</strong></td>
<td><strong>Evergreens.</strong></td>
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<td></td>
<td><strong>Make a bird nest census.</strong></td>
<td><strong>Lightning and thunder.</strong></td>
<td><strong>Make aquariums.</strong></td>
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<td><strong>Test crop seeds for vitality.</strong></td>
<td><strong>Cause of rain and snow and hail?</strong></td>
<td><strong>Study fishes and other animals in aquarium.</strong></td>
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<td></td>
<td><strong>Watch winter bud development.</strong></td>
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<td><strong>Which are leaf and which are flower buds?</strong></td>
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<td></td>
<td><strong>Find stamens and pistils of elm, ash, box elder, mulberry, cottonwood.</strong></td>
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<td><strong>Find frog's eggs and hatch in a jar of creek water.</strong></td>
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<td><strong>SPRING.</strong></td>
<td><strong>Grow vegetable gardens. Start tomatoes in the schoolroom.</strong></td>
<td><strong>Pollination and fertilization of flowers.</strong></td>
<td><strong>Encourage the raising of pigs and chickens.</strong></td>
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<td><strong>Hatch chickens.</strong></td>
<td><strong>Grafting and budding.</strong></td>
<td><strong>Observe and study habits of wild animals.</strong></td>
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<td></td>
<td><strong>Relation of insects to gardens and fruit.</strong></td>
<td><strong>How fruits are produced.</strong></td>
<td><strong>Relation of rats, mice, gophers, ground squirrels, and snakes to crops and poultry.</strong></td>
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<tr>
<td></td>
<td><strong>Relation of birds to gardens and fruit.</strong></td>
<td><strong>Tree diseases and other enemies.</strong></td>
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III. Animal Studies.

1. Birds.

BIRDS AND BOYS.

At a certain age boys go through a period of savagery, when they are likely to enjoy torturing animals, teasing their smaller brothers, sisters, and playmates, and killing birds and toads.

It is something of a racial instinct and is to be guided rather than repressed. The interest in living things is a natural and worth-while one.

Boys will not stop killing birds by being told not to do it, by being “talked to,” by being punished for it, nor by having laws passed against it. Think over the following:

The boys of the second and third grades in a certain town in western Kansas during the winter made wren houses out of chalk and cigar boxes, while the girls were at work with other forms of busy work. Pocketknives were the chief tools. The hole in the house was made the size of a quarter (25-cent piece)—too small for sparrows.

The boys put up their boxes in suitable places and they could hardly wait until the birds began to appear. More than once the writer was stopped on the street by an excited boy with, “Oh, Mr. Wooster! I saw a pair of wrens looking at my house today!”

When hoeses.

Do you suppose that one of these boys would stand complacently by and watch some other boy throw stones at his birds? And not only is he proud of his own birds, but his new-born interest extends to all the good birds, and even to other animals, for his attitude toward living things has become a kindly one.

The building of that wren house was worth more than all the laws, ordinances, regulations and preachments ever promulgated against those “awful boys.”

And what sort of a schoolroom do you suppose such work came from? Do you suppose that those boys disliked school? Do you suppose that their reading, writing and arithmetic suffered? Or is it possible that all their other school work profited by the interest and the spirit that came from that wren house?

Such work is not a panacea for all ills; it will not stop boys from being cruel to animals entirely, but it helps tremendously, and in time the savage instinct is outgrown.

HOW TO MAKE A BIRD HOUSE.

Bird houses for this region, at least as a starter, should be for wrens, and the following directions are for wren houses.

1. Use a chalk box, cigar box (large cubical kind), tin can, hollow log, or anything else which you think suitable.
2. Make a hole the size of a quarter (25-cent piece). Such a hole is too small for sparrows but big enough for wrens. Make the hole nearer the top than the bottom of the box, can or log.

3. Make a roof that is waterproof.

4. It is better to have a few small holes near the top of the end of the box opposite the entrance, for ventilation.

**A BIRD BATH.**

Birds appreciate a drinking and bathing place. A basin buried in the ground with its edges level with the surface of the ground and kept filled with fresh water daily will make a good bird bath.

Better yet, scoop out of the ground a shallow basin, about three feet across and three inches deep in the center, and line it with cement.

The bird bath should be located in an open space, far enough from shrubs that the birds will not be afraid of cats and other enemies, but near enough to trees to attract the birds and make a shelter for them.

The birds attracted by such a bird bath will soon pay for it in the insects which they will destroy.

**FEEDING BIRDS IN WINTER.**

Chickadees (often called snowbirds) and other winter birds are fond of suet, doughnuts and other food in the winter, especially when snow covers the ground.

Hang a piece of suet or a doughnut from the limb of a tree and watch results.

Chickadees often become quite tame when quietly and patiently fed.

**KEEP A BIRD RECORD.**

In the winter keep a record of the birds seen by the children. What birds stay here all winter?

Early in the spring begin to watch for the return of the birds. On the blackboard start a record of the return of the birds, giving the date of the first sight of each and the child who first saw it.

Each pupil should also keep a record of the birds as he sees them or learns to recognize them. This can be kept individually, or, better yet, on the blackboard or a large sheet of paper in chart form, where all can see it.

**WESTERN KANSAS BIRDS.**

The following are the most common western Kansas birds. How many do you know at sight?

<table>
<thead>
<tr>
<th>Robin.</th>
<th>Orchard oriole.</th>
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<tbody>
<tr>
<td>Western house wren.</td>
<td>Flicker.</td>
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<tr>
<td>Chickadee.</td>
<td>Downy woodpecker.</td>
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<tr>
<td>Blackbird.</td>
<td>Red-headed woodpecker.</td>
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<tr>
<td>Red-winged blackbird.</td>
<td>Kingbird (white breast).</td>
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<tr>
<td>Yellow-headed blackbird.</td>
<td>Arkansas kingbird (yellow breast).</td>
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<tr>
<td>Cowbird.</td>
<td>Kingfisher.</td>
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<tr>
<td>Crow.</td>
<td>Barn swallow.</td>
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<tr>
<td>Blue jay.</td>
<td>Cliff swallow.</td>
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<tr>
<td>Catbird.</td>
<td>Mockingbird.</td>
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</table>
Indigo bunting.  
Lark bunting.  
Black-headed grosbeak.  
Western blue grosbeak.  
Meadowlark.  
Quail (bobwhite).  
Prairie chicken.  
Killdeer.  
Horned lark.  
Yellow-billed cuckoo (rain crow).  
Nighthawk.  
Butcher bird (shrike).  
Bluebird.  
Dickcissel.  
Warblers.  
Western lark sparrow.  
English sparrow.  
Western field sparrow.

BIRD STUDIES—QUESTIONS AND SUGGESTIONS.

1. Notice the differenceshaped bills among birds. How does the kind of bill indicate the kind of food habits of the bird? Compare the English sparrow’s and the robin’s bills.

2. How do the feet of birds indicate their habits? Give examples. Compare robin, woodpecker, duck, killdeer.

3. How many toes has a robin on each foot? a woodpecker? a chicken?

4. What is the position of the toes of a woodpecker?

5. Can a woodpecker go down the trunk of a tree as well as up?

6. Compare the flight of different birds. What ones fly in a horizontally straight line and what ones in a wavy line?

7. Can you recognize birds by their flight?

8. What birds eat mostly seeds for their food? What ones insects? Which is the more beneficial?

9. What birds are the most useful to man?

10. What birds stay here all winter?

11. What birds which do not nest here are quite abundant in the spring as they pass through on their way farther north?


13. How many bird songs and calls can you recognize? Listen for them.

14. Why do birds migrate? How do they find their way thousands of miles? Do the same birds come back to the same place each year?

2. Insect Studies.

THE HOUSE FLY.

1. Look at a fly under a magnifier. Can you see its eyes? How many has it? Are they like human eyes? How far can a fly see?

2. Can you see the fly’s tongue? Put some sugar on a table and watch the flies eat it.

3. How many wings has a fly? Sure?

4. How many legs has a fly?

5. Where do flies come from?

6. Do small flies grow into bigger flies?

7. Do flies prefer clean places or dirty places?

8. How can flies be destroyed?

THE MOSQUITO.

1. Find some wigglers in a rain barrel or elsewhere. Put them in water in a glass jar and cover the jar with netting. Then watch the wigglers.

2. Why do they come to the surface?
3. Why will oil on the water kill them?
4. How many wings has a mosquito? How many legs?
5. How do mosquitoes pierce the skin of a person?
6. What diseases do mosquitoes cause? Can any mosquito cause these diseases? Do all mosquitoes bite?
7. How can mosquitoes be destroyed?

**BUTTERFLIES AND MOTHS.**

1. How does a butterfly differ from a moth?
2. How many wings has a butterfly? How many legs? Same for moths.
4. What are they before they are butterflies?
5. Most "worms" and caterpillars are but one stage in the growth of butterflies, moths or other insects. How can one tell whether a worm is just a worm or one stage of growth of an insect?
6. How does the manner of eating of a caterpillar differ from that of an adult butterfly?

**GRASSHOPPERS.**

1. How many wings has a grasshopper? How many legs?
2. How does the manner of eating of a grasshopper differ from that of a butterfly?
3. Do grasshoppers ever pass through a worm stage?
4. How do grasshoppers make the noises they do?

**INSECTS IN GENERAL.**

1. What is an insect, anyway? Is a spider an insect? How many legs has a spider? How many wings? eyes?
2. Do all insects have the same number of legs? of wings? of eyes?
3. Insects are divided into the following groups (called orders). (We give only the more common ones.) Those in the same group are near relatives. Can you tell what their family resemblances are?
   (a) Butterflies and moths. How can you tell moths and butterflies apart. (Lepidoptera.)
   (b) Beetles; for example, potato beetle, May beetle (or June bug), ladybird beetle. (Coleoptera.)
   (c) Bugs. Sometimes the word "bug" is used rather promiscuously, as above in "June bug," but it should be used only for certain insects, as the chinch bug, box-elder bug, squash bug. Lice (most kinds) are degenerated bugs. (Hemiptera.)
   (d) Grasshoppers, crickets, katydids, walking sticks. (Orthoptera.)
   (e) Bees, wasps, ants. (Hymenoptera.)
   (f) Flies and mosquitoes. (Diptera.)
   (g) Dragon flies and damsel flies. (Odonata.)
4. Each order has fairly definite characteristics. Whenever you see an insect see if you can place it in the proper order and tell why you place it there.
5. The members of some orders of insects pass through four distinct stages, namely, egg, larva (worm or caterpillar), pupa (chrysalis and cocoon, for example); when the adult appears it is fully developed. Butterflies and moths are examples of this sort of development, which is called complete metamorphosis, or indirect development.
6. The members of some orders of insects hatch from the egg directly into approximately the adult form, though they may grow and develop much before they are mature. This type of development is called incomplete metamorphosis, or direct development. Grasshoppers are an example.
7. The next time that you find some caterpillars feeding, put them in a jar and keep them supplied with the kind of food on which they were feeding when you found them. Keep a couple of inches of earth in the jar. Watch results.

8. How does a cricket sing? a cicada? Put a cricket or two in a glass jar in a darkened place and watch their “singing.” Do they all sing? Explain.

9. Can insects hear?

10. Do insects have any bones?

11. Does an insect have a nose?

12. Do ants really talk with their feelers?

13. What kind of mouths have insects? Do they all have the same kind?

14. How does the kind of mouth an insect has determine how it is to be destroyed if it is a harmful one?

15. Name some harmful insects. Why are they harmful?

16. Name some useful insects. Why are they useful?

17. Familiar “worms,” which are the larva stage of insects, mostly have legs. True worms do not. The angleworm is about the only “just worm” with which most people are familiar. It has no legs, and is not the larva stage of any insect. It is just a worm. Leeches, tapeworms, the trichina (found in pork), are other worms which are just worms.

18. Of what insect is each of the following “worms” the larva stage: silkworm? common white grub worm? tomato worm? cabbage worm? cut worm? army worm?

19. How does the lightning bug (firefly) make its light?

20. Out of what do bees make honey? the comb?

21. Some insects sting the stems, leaves or buds of plants, lay their eggs inside, and the stem, leaf or bud swells to abnormal size. This swelling is called an insect gall. They are often found on goldenrod stems, elm leaves, and hackberry leaves and twigs.

**AN ARTIFICIAL ANT HILL.**

Obtain a glass jar having as large a diameter as possible. A quart or two-quart fruit jar will do, but a jar a little larger in diameter would be still better.

Fill the jar about half full of earth from an ant hill. Put a shovelful of ants in too.

Wrap a piece of cloth (preferably black) around the jar to keep the light out.

The ants will make some of their tunnels next to the glass. After a day or two take off the cloth and see what they have done. Then put it back on.

Watch the ants at work on top. How do they carry things? Do they have eyes? ears? wings? How many legs has an ant? What do they eat? The ants need plenty of moisture. Keep a piece of raw apple or potato in the jar so that the ants can get water. Put some pigweed seed in the jar. What becomes of it? Try other seeds too.

**3. Fishes.**

1. Keep native fishes in your aquarium rather than goldfish.

2. How many kinds of fishes can you find? Can you name them?

3. How many paired fins has a sunfish? a catfish?

4. For what do fishes use their fins? Are you sure? Watch and see.
5. For what do fishes use their tails?
6. Can fishes hear? Does a fish ever go to sleep? Does it have eyelids?
7. Which does the more harm, when fishing, making loud noises or running around on the bank?
8. For materials on the care of fish in an aquarium see the article in this bulletin on Aquariums. Find some fish eggs for the aquarium, if possible.

4. Toads, Frogs and Salamanders.

In March and April watch for frogs' eggs in quiet, shallow water of streams and ponds. The eggs are jellylike globules in masses, with a dark spot in the center of each globule. Usually the mass, which is about the size of one's fist, is fastened to a twig or weed in the water. If one wishes to raise tadpoles, the eggs can be put in a jar of the water in which they were found. The water should be changed every few days. The tadpoles eat plant life in the creek and should be supplied with algae and other organic matter, including mud.

Toads' eggs are found in ponds in May or June. Their eggs are about like the frogs' eggs, except that they are in strings instead of masses. They can be raised in the same way. Their tadpoles develop faster than those of frogs.

Salamanders (sometimes called mud puppies) are found in cellars, old wells and cisterns, and in muddy pools, ponds and streams. They can be kept in shallow water in an aquarium or jar. They eat worms and small scraps of meat. Do not leave uneaten food in the aquarium.

Toads, frogs and salamanders are harmless. Toads do an immense amount of good. Salamanders are worth keeping in the schoolroom, for a time at least. Children can easily become accustomed to such animals, and should be given opportunity to do so, if for no other reason than to counteract the silly superstitions and misinformation so abundantly heaped upon the reputations of these perfectly harmless animals.

These three animals are known as amphibians. Why?

FROGS.

1. Where do the frogs live? Why is it hard to see a frog if he is not moving?
2. Why is a frog always cold and slippery?
3. Where are the frog's eyelids? How does it sleep?
4. What does it eat?
5. How does it catch its food?

TOADS.

1. What is the difference between a toad and a frog?
2. What is the food of a toad?
3. Are they harmful or helpful or neither?
4. Where are they during the day? Why?
5. Why does a toad feel cold?
6. Why does it live in a damp place?
7. How does a toad drink?
8. Why is it hard to see a toad before it moves?
SALAMANDERS.

Salamanders are sometimes found around buildings after a rainy spell of weather.
1. Color: Yellow and black spotted.
2. Shape: Long and slender.
3. Food: Very little; plant lice and worms.
4. Examine its eyelids.
5. Where does the salamander live?
6. Is it dangerous or harmless?

5. Miscellaneous.

CRAYFISHES, MUSSELS AND SNAILS.

CRAYFISH.
1. Its common name?
2. How does it move in water? on land?
3. Find the home of the crayfish.
4. How many eyes has the crayfish? How does it shut them?
5. How many parts is the body divided into?
6. Value of the crayfish?

MUSSEL.
1. How does the mussel move? eat?
2. Use of the mussel?
3. Use of the mussel shells?
4. Where are mussels usually found?
5. Can you tell the age of a mussel by its shell?

SNAIL.
1. How does the snail move?
2. How does the snail see?
3. Are snails of any value or harm?
4. Keep some snails in a jar. Watch them.

TURTLES, LIZARDS AND SNAKES.

These three animals are reptiles, and are rather closely related, though they differ quite a little in general appearance.

Here again we find much misinformation, particularly about snakes.

For example, the writer has heard people say over and over again that the hog-nosed snake, or spreading adder, or hissing viper, as it is variously called, is deadly poisonous. As a matter of fact, we have no more harmless snake.

Help the children learn to recognize the turtles, lizards and snakes by their names, and try to find out the facts about them from authoritative sources, so that misinformation, fear and superstition may disappear.

1. What kinds of turtles do you have in your region? Where does each live?
2. What is their covering for?
3. What do turtles eat?
4. Keep a turtle in an aquarium for a while. Feed it.
5. Lizards, swifts, etc., are found most among the rocks and sands of our hills. How many kinds can you find?
6. Our commonest snakes in this region are the hog-nosed snake, the bull snake, the blue racer, garter snakes, and rattlesnakes. Of these only the rattlesnakes are poisonous.
RABBITS, SQUIRRELS, GROUND SQUIRRELS, ETC.

These animals are our most familiar wild representatives of the mammals. There are plenty of opportunities for valuable observation of these animals. The ones named above are known as rodents, because they gnaw. What kind of teeth have they?

Can you tell, from a rabbit’s tracks in the snow, how it was traveling?

There are numerous other opportunities to study mammals, but we will not take time to mention them here.


Children constantly ask for the names of things. This desire is not alone for names, but even more to tie up new and unfamiliar things with familiar—to find relationships between them.

For example, when we saw a zebra for the first time we probably recognized that it must be related to the horse. A child would readily recognize that a coyote looks like a dog and that a tiger look like a big cat.

On the other hand, one would not so readily recognize that the mouse is related to the rabbit. Think over the following questions, which are merely suggestive:

1. Is the whale a fish?
2. Is the bat a bird?
3. To what familiar animals is the fox related? the pig? the moose? the raccoon?

See further questions at the close of this subject.

To aid teachers in answering such questions we give the following outline of the animal kingdom.

AN OUTLINE OF THE ANIMAL KINGDOM.

The animal kingdom is divided into two parts, known as vertebrates and invertebrates. If an animal has bones, including a backbone, it is a vertebrate. If it has no bones, as we commonly know bones, it is an invertebrate.

The more familiar and important animals belonging to these two groups are:

INVERTEBRATES.

1. One-celled animals: Amoeba, malarial and yellow-fever parasites. (Protozoa.)
2. Sponges. (Porifera.)
3. Jellyfishes, sea anemones, corals. (Cœlenterata.)
4. Tapeworms, sheep-liver fluke. (Flat worms.)
5. Hair worms (the kind that some people think come from horse hairs), trichina (a parasite found especially in pork). (Round worms.)
6. Starfishes. (Echinodermata.)
7. Angleworms and leeches. (Annelata.)
8. Mollusks: Clams, oysters, mussels, snails. (Mollusca.)
9. Insects, spiders, crayfishes, lobsters, crabs, centipedes and millipedes (“thousand-legged worms”). (Arthropoda—jointed legs.)

VERTEBRATES.

1. Fishes.
5. Mammals: Horses, cows, sheep, dogs, cats, deer, lions, bear, mice, rabbits, squirrels, elephants, camels, monkeys and human beings are examples of mammals.
Mammals are divided into several groups, the more familiar of which are as follows:

1. Young carried in a pouch, as opossum, kangaroo; called marsupials.
2. Hind limbs wanting; fingers not distinct: Whales, porpoises.
3. Front limbs in the form of wings: Bats.
4. Incisor teeth large and sharp; no canine teeth: Mice, rats, squirrels, rabbits, gophers, beavers; called rodents.
5. Canine teeth large and sharp; flesh-eating: Cats, dogs, tigers, lions, bear, etc.; called carnivores.
6. Animals with hoofs, called ungulates, divided into several subgroups, as follows:
   a. Five toes, tusks, nose elongated: Elephants.
   b. One toe on each foot: Horse, mule, zebra.
   c. Three toes: Rhinoceros.
   d. Animals which chew cud; no upper front teeth: Cattle, sheep, bison (buffalo), camels, antelope; called ruminants.
   e. Do not chew cud; upper front teeth present: Hogs, hippopotamus.
   f. Fingers and toes with nails: Monkeys, apes, man; called primates.

Notes and questions concerning animals in general.

1. Most of the invertebrate animals live in water and get their food therefrom. The insects are largely an exception.
2. Among the invertebrates it will be noted that there are some disease-producers and some pests of man and beast. There are also some animals used for food, particularly the oysters. Corals have built up islands. Mussel shells are used for pearl.
3. Among the insects, of course, there are many pests, and, on the other hand, quite a few helpers of man. Bees furnish honey, silkworms furnish silk, and there are other ways in which they are useful. What are they?
4. The group of animals containing the insects, crayfish, etc., is the lowest to have real, sure-enough legs, and they are the only invertebrates to have them.
5. Compare the body coverings of the five groups of vertebrates. The fishes have scales. The amphibians have? the reptiles? birds? mammals?
6. Do any vertebrates have more than four limbs?
7. Do any vertebrates have fewer than four limbs?
8. Do the fins of fishes correspond to four limbs?
9. Do snakes have any remnants of bones of four limbs?
10. Do the wings of birds have in them the same bones as the fore limbs of other vertebrates?
11. Do the bones of the skull of one animal, in general, correspond to those of any other animal?
12. To what other animals are the following most closely related: foxes? badgers? leopards? giraffes?
13. Is the ostrich a bird? is the turkey? duck?
14. Can you tell to what class any animal belongs by its teeth?
Can you recognize these trees from their barks!
IV. Plant Studies.

1. Trees, Shrubs and Vines.

WESTERN KANSAS needs trees, shrubs and vines. It may be that there are few available for study. But that is so much the more reason why opportunity should be found to observe and study them, that an interest in them may be developed.

The following topics indicate studies which can be made:

1. Tree recognition.
   (a) By leaves; size, shape, margin, veining.
   (b) By twigs; size, shape, color of bark, buds alternate or opposite.
   (c) By bark; rough or smooth, color, markings.
   (d) By general shape; each kind of tree has something of a typical shape.

2. Wood. Learn to recognize kinds of wood. Study the grain of wood.


4. Arbor and Bird Day.

2. Tree Recognition.

LEAVES.

1. Gather leaves of trees, shrubs and vines and press them. Name them.

2. Learn to distinguish leaves by comparing them. Answer the following questions about any leaf when you study it:

3. Is it simple or compound? A compound leaf is a leaf really made up of several leaflets, as the honey locust, clover, walnut.

4. Draw a design of the veining of the leaf. Compare with others.

5. What kind of a margin has it? Compare elm and hackberry leaves as to veining and margins.

6. Hold leaves up before the class one at a time and let the children try to name them on paper. See who can name the most. See who can improve most before the next time a test is given.

TWIGS AND BUDS.

1. Can you tell the age of twig by its bark?

2. Are the buds on the twig alternate or opposite?

3. Name the trees having opposite buds. Same for alternate.

4. Compare the color of twigs. For instance, compare ash and box elder. How do they differ?

5. Do you notice little dots on the bark of twigs? What are they? Notice them on a cherry twig. They are longer than on some other twigs. They are called lenticels. What are they for?

6. Some twigs are chunky and some are slender, some are straight and some are angular.

7. Notice the shape of the buds of twigs. How do they differ on different trees?

8. Winter is the best time to study twigs and buds. The twigs in the cut are: (1) Cottonwood (pistillate buds); (2) sumac; (3) box elder; (4) choke cherry; (5) cottonwood (staminate buds); (6) elm (seeds).
BARK.

1. It takes much practice to learn to recognize trees by their bark, but it is worth trying, especially in the winter.
2. What makes bark rougher on some trees than on others? Why is it rough at all?
3. Gather samples of bark, but only from dead trees. Hold them up one at a time and let the children try to name them.
4. The names of the pictures of bark in the accompanying cut are as follows:

GENERAL SHAPE OF TREES.

1. Every kind of tree has a more or less typical shape by which it can usually be recognized at a distance. General color of the foliage also helps.
2. Make an outline drawing of the shape of the following trees: Pine, elm, apple, cedar, cottonwood, ash.

WOOD AND THE GRAIN OF WOOD.

1. Gather samples of as many kinds of wood as possible. There are nearly always buildings in course of construction in the neighborhood, where samples of several kinds of wood can be obtained.
2. Of what kind of wood are the following articles made?
3. Classify woods according to natural color. What ones are red? white? yellow?
4. Of what kind of wood is the woodwork in the schoolroom made?
5. Name some hard woods. Some soft woods.
6. What kind of wood is the heaviest? the lightest?
7. What makes the grain of wood? Follow the annual rings around all six sides of a cubical block of wood.
8. What is meant by quarter-sawed oak? Why is it mentioned only in connection with oak?
9. What are medullary rays?
10. How can one tell the age of a tree if the end of the log or stump can be seen? Can you tell from it what years were "good" years and what ones "bad" years?

SHADE TREE FLOWERS AND FRUITS.

1. In the late winter watch the buds on the shade and fruit trees. From time to time as spring approaches notice them again.
2. Try to determine which ones are leaf buds and which ones flower buds. For instance, there are two kinds of buds on elm trees. Find them. Then when the buds begin to open, watch for your proofs.
3. Many people are surprised when they hear that elm trees, ash trees, box elders, cottonwoods, etc., have flowers. When they think of flowers they think of bright-colored or showy petals. As a matter of fact, bright-colored petals are comparatively unimportant. But these trees have the essential organs (stamens and pistils) of flowers and produce seed just as efficiently as an apple blossom does.
4. The stamens and pistils of the flowers of shade trees are, on some species of trees, on separate trees; in others on the same tree, but in separate blossoms, and in some in the same blossom. How is it with the cottonwood? the mulberry? ash? elm? box elder? honey locust? Do all mulberry trees bear fruit?

5. Do all cottonwood trees have cotton on them? Explain.

6. Notice the stamens and pistils of the ash, box elder and cottonwood in the accompanying cut. The cherry blossoms are put in for comparison.

7. Collect tree seeds. Drop the different kinds and watch them fall.

**ARBOR AND BIRD DAY.**

The above day is described and suggestions are made for its observance under the heading of “Special Days.”
COMMON WEEDS. NAME THEM.

Recognition of our common weeds, wild flowers, crops and vegetables is one of the important parts of childhood's desire to know what things are; and not merely names, but relationships as well. (For a list of common weeds see the general topic of "Collections" toward the back of the bulletin.)

By means of flowers, leaves, stems, roots, fruits and seeds we can learn to recognize plants, and not only name them but recognize their family characteristics. The weeds in the cut are: 1, Mule tail; 2, narrow-leaved sunflower; 3, tall verbena; 4, horse mint; 5 and 6, wild lettuce (two kinds); 7, giant ragweed; 8, wax weed; 9, pigweed (red root); 10, lambsquarter; 11, bull thistle; 12, prickly poppy.

FLOWERS.

1. It is important first to know the parts of a flower—sepals, petals, stamens and pistil.

In an apple blossom, for example, the outside parts, which we see as the outside of the bud, are called sepals (all taken together, the calyx). The conspicuous parts, which make the flower a "flower" to most people, are the petals (all taken together called the corolla). Next come the stamens, which contain the pollen in their anthers; and then in the middle of the flower is the pistil (or pistils), at the base of which is the ovary, containing the ovules, which develop into seeds when fertilized by the pollen.

2. Count the sepals, petals and stamens of various flowers. What do you notice?

3. If a flower has five sepals can you take it for granted that it has five petals and five stamens? or perhaps some multiple of five?

4. There are three different numerical plans of flowers—those in threes, those in fours, and those in fives.

5. Do you notice any particular kind of plants which have a numerical plan of three? What kind of leaf veining do they have?

6. What kind of veining of leaves do plants have whose flower parts are in fours or fives? See if you can discover. Keep a record of flowers on these various points and it will show you several things.

7. A certain shape of flower is often a characteristic of a certain family. Notice whether the petals of any certain flower are united, as in the morning-glory, potato, honeysuckle and lilac blossoms; or separate, as in the rose, apple, mallow, poppy and geranium blossoms. The petals of some flowers are not all the same shape, as in the sweet pea, violet, pansy and mint.

8. The number and arrangements of the stamens of flowers usually show some family resemblances. For example, in most legume blossoms (peas, beans, alfalfa, clover, etc.) there are ten stamens fastened together by their little stems (called filaments), except that in some members of the family nine of the stamens are fastened together and the tenth one is separate and alone.

The mallow family has many stamens fastened together in a column, which can always be recognized when one becomes familiar with it. For example, look at a hollyhock blossom (it belongs to the mallow family).
9. Composite flowers are heads of many flowers looking like a single flower. Sunflowers, asters, Shasta daisies, dandelions, chrysanthemums, thistles, wax weed, goldenrod and lettuce are examples. They all belong to what is known as the composite family. They show their relationship in other ways than just by their flowers. This is the largest of all plant families.

LEAVES AS FOOD FACTORIES.

Leaves are the great food factories of the earth. All the food which we eat is made in the leaves of plants, directly or indirectly; directly in the case of plant foods, and indirectly in the case of animal foods, for the animals which we eat eat vegetable foods, or they ate animals which ate animals which eat plant foods.

It is in the leaves of plants that all these foods are manufactured, and mostly out of two very cheap substances—water and carbon dioxide (from the air). Chemists know the composition of these foods, but no chemist has ever been able to manufacture starch. And so we have to grow plants, that those plants may grow leaves, that those leaves may make our foods—wheat, corn, potatoes—and how we watch for rain that the plants may do these things!

Some plants, when the food is made, store it underground, as in potatoes, beets, onions, turnips and carrots. All seeds have food stored in them, and so we eat the seeds of plants. Then we often eat the leaves and stems of plants, too. The fruits also often contain valuable foods (besides that in the seeds).

PLANT FAMILY RESEMBLANCES IN LEAVES.

1. Leaves, according to their veining, are divided into two classes—those which have net veining and those which have parallel veining. Tree leaves, most weed leaves and most of our vegetable crop leaves are of the net-veined sort. Look at an elm leaf and see the network of veins. Grass leaves (corn and wheat are big members of the grass family), lily leaves, iris leaves and onion leaves are examples of the parallel-veined sort.

2. An interesting fact is that plants with net-veined leaves are of the sort that have flowers built on either the four or five plan, and those with parallel-veined leaves are built on the three plan.

3. Some leaves of the net-veined sort are of a palm-leaf shape, and are called “palmately veined” leaves, as in a nasturtium, geranium, or maple leaf. Such leaves are usually broad.

4. The other net-veined leaves have one mid-vein and then numerous side veins, like a feather. They are called “pinnately veined” leaves, meaning featherlike.

5. These various characteristics of leaves run in families. And so leaves reveal family relationships too.

6. Examine a large number of leaves and classify them according to these various characteristics.

4. Fruits.

For convenience, fruits or seed vessels of all plants are divided into two classes—dry and fleshy. What we commonly call fruits in the grocery-store sense, such as apples, cherries, strawberries and watermelons, are of the fleshy kind. Beans, peas (pod and all), dandelion seeds (with their parachutes), grain, shade-tree seeds and the fruits of weeds and wild flowers in general are of the dry kind.

APPLE.

Take the apple as an example of a fleshy fruit.

1. How do the stem and withered flower happen to be at opposite ends of the fruit? Is a peach that way?
2. What are the dots on the skin of an apple? Do they have a purpose?
3. How many seeds has an apple? If there are not the regular number, what is the reason? Sometimes apples are dwarfed on one side. Explain.
4. Do the seeds point toward the stem or the flower end?
5. Cut an apple in two (cross-section). Notice the lines of the core. What is the core? That is, what part of a fruit does it represent? Why do not all fruits have a core? How many divisions to the core?
6. Do you notice the dots outside the core in the flesh of the apple? How many are there? What are they?
7. Cut an apple in two vertically. What do you notice? In an apple, what part of the structure of the seed vessel do we eat?
8. In a watermelon, what part of the structure of the seed vessel do we eat? Is there a core? How many divisions in a watermelon?
9. Study other fruits in the same way: tomato, orange, grape, cherry.
10. Most of the fleshy fruits belong to the rose family. The rose bush, apple tree, peach, pear, quince, cherry, plum, strawberry, raspberry and others all belong to this family. Perhaps you had not thought of a rose bush and an apple tree as being related.
11. The watermelon, muskmelon, squash, cucumber, pumpkin and wild gourd all belong to the gourd family. Does every blossom, in any of these, bear fruit? Explain. Observe, if possible.
12. How do these fruits come to have flesh? Is it of any advantage to them? Did they have as much in the wild state?
13. The children can bring different varieties of apples to school and learn to know them.

**D R Y F R U I T S.**

Some dry fruits are in the form of pods, as beans, peas, honey locusts (all legumes); some are in capsules, as yucca (or soapweed); some are in the form of nuts, and some have the seed vessel so tightly adherent to the seed itself that it has become just a part of the seed coat as in the grains and many weed seeds.

Seed vessels with spines, hooks, claws, wings, parachutes, and other contrivances by which they get transported, are interesting to collect and examine.

Examine such seeds as cocklebur, beggars' ticks, stick-me-tights and Spanish needles under a magnifying glass.

**S E E D S.**

1. Get a pigweed (red root) and rub its head on a newspaper. Do you find some little black, shiny seeds? Try other weeds in the same way; for example, dock, smartweed, prickly poppy, foxtail, ragweed, dodder, vining buckwheat (black bindweed), devil's claw, wild lettuce and wild sunflower.
2. Autumn is the best time to gather weed seeds, though during the summer there are many seeds ripe enough.
3. Vegetable, crop and flower seeds can be gathered also in the fall, but often there is a better opportunity to obtain them for a collection in the spring, particularly vegetable and flower seeds.
<table>
<thead>
<tr>
<th>Weed Seed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tall Primrose</td>
</tr>
<tr>
<td>Sandbur</td>
</tr>
<tr>
<td>Thistleweed</td>
</tr>
<tr>
<td>Sedge Grass</td>
</tr>
<tr>
<td>Milkweed</td>
</tr>
<tr>
<td>Cocklebur</td>
</tr>
<tr>
<td>Russian Thistle</td>
</tr>
<tr>
<td>Daisis Glay</td>
</tr>
<tr>
<td>Wild Sunflower</td>
</tr>
<tr>
<td>Wild Lettuce</td>
</tr>
<tr>
<td>Yucca</td>
</tr>
<tr>
<td>Spanish Needle</td>
</tr>
<tr>
<td>Iron Weed</td>
</tr>
<tr>
<td>Lamboquater</td>
</tr>
<tr>
<td>Fox Tail</td>
</tr>
<tr>
<td>Prickly Poppy</td>
</tr>
<tr>
<td>Dodder</td>
</tr>
<tr>
<td>Buffalo Bur</td>
</tr>
<tr>
<td>Small Ragweed</td>
</tr>
<tr>
<td>Large Ragweed</td>
</tr>
<tr>
<td>Loco</td>
</tr>
<tr>
<td>Pig Weed</td>
</tr>
<tr>
<td>Wild Gourd</td>
</tr>
<tr>
<td>Buckwheat</td>
</tr>
<tr>
<td>Ilokk</td>
</tr>
<tr>
<td>Smartweed</td>
</tr>
<tr>
<td>Horse Weed</td>
</tr>
<tr>
<td>Sage Mint</td>
</tr>
</tbody>
</table>

Can you find samples of these seeds!
4. By means of seeds one is often able to discover not only names of plants, but also to find family relationships. Compare dock (several kinds), vining buckwheat (black bindweed), smartweed, rhubarb and buckwheat seeds. What do you notice?
   Compare watermelon, wild gourd, squash, pumpkin, cantaloupe and cucumber seeds.
   Compare peas, beans, alfalfa, clover, honey locust and loco seeds.

5. For further materials on seeds, seed collecting, and a description of a case for seed collections, look under "Collections," farther along in this bulletin (see Table of Contents). See, also, the cut showing pictures of some of our common weed seeds.

**SEED GERMINATION.**

In the early spring germinate squash, corn, wheat, beans and other seeds, as follows:
1. Soak the seeds overnight, each kind separately.
2. Put blotting paper, sawdust or sand in a plate, saucer or pie tin; moisten, and place the seeds on it and cover with a piece of window glass, or, better yet, a glass jar or tumbler to keep the moisture in.
3. From day to day watch the changes in the seeds. Ask the children to report what they notice.
4. What seeds show two seed leaves? What seeds show only one seed leaf? What difference is there in the plants?
5. Are these seed leaves different from the regular leaves of the plant?
6. Break open a dry seed and also a soaked one, and see if you can find these seed leaves. Do you find anything else? Use a magnifier.
7. Plant some seeds in soil and see how they come up? Should one help out the seeds by lifting off the soil when it begins to break? Explain.
8. Germinate some weed seeds as well as crop seeds.
9. Plants whose seeds come up with two seed leaves are the same ones whose flowers are numerically on the four or five plan and whose leaves are net-veined. What kind of seeds have the plants whose flowers are on the three plan, and whose leaves are parallel-veined? Watch weeds, vegetables, flowers and crops for the same thing, as they come up in the spring.
10. Test six kernels of corn from each of several ears by germinating them, keeping the six kernels from each ear separate and keeping track of the ear from which each set of six came. Do they all germinate with equal vigor? Do kernels from some ears not germinate at all, or only partially? Suppose that that ear were used for seed corn?

Flower in the crannied wall,
I pluck you out of the crannies,
I hold you here, root and all, in my hand,
Little flower—but if I could understand
What you are, root and all, and all in all,
I should know what God and man is.—Tennyson.

5. **Plant Relatives.**

Recognition of plants at sight becomes much easier when one has learned to know family characteristics. To illustrate we give a few examples:

1. The members of the mint family have square stems, a two-lipped flower (something like an open mouth), opposite leaves, mostly with the typical mint odor, and a little four-seeded fruit.
2. The potato (nightshade) family contains more or less of a narcotic poison, in certain parts of the plant. This family includes the potato, tomato, tobacco and deadly nightshade.
3. The members of the pea or pulse family mostly have the typical pea blossom, compound leaves, fruits a pod, and are rich in nitrogen, which makes them valuable for food.

And so by typical features we can learn to recognize plant families. We give more plant families a little farther along. But in order to understand more about plant classification we will begin at the beginning.

THE TWO DIVISIONS OF THE PLANT KINGDOM.

The plant kingdom is divided into two subkingdoms:

I. Nonflowering Plants.
   1. Algae, seaweed, bacteria, yeast, molds, mushrooms, fungi, etc.
   2. Mosses.
   3. Ferns and horsetail scouring rushes.

II. Flowering Plants. (Three divisions.)
   1. Grasses, lilies, and other plants with seeds not in halves, mostly with parallel-veined leaves and flower parts in threes. Called "mono-cotyledons" (meaning one seed leaf).
   2. Plants with seeds in halves (two seed leaves, or "dicotyledons"), leaves net-veined, and flowers mostly built on the four or five plan. A large majority of our weeds, trees and vegetable crops belong here.
   3. Coniferous plants, or "evergreen" trees (cone-bearing). Called "polycotyledons."

NONFLOWERING PLANTS.

1. Algae are the plants, often wrongfully called "moss," which grow on the rocks in streams. Other kinds float on the surface of water and make the green scum so often seen when water gets stagnant. Other kinds grow on damp foundations, posts and the bark of trees, as a more or less faint green covering.

2. Bacteria are plants. Some of them are the causes of our worst diseases. Some are great helpers of mankind.

3. Yeast is a plant. A yeast cake is made up of these tiny plants (in a dormant state) and corn meal or other starchy material.

4. Mold is a plant, and like bacteria and yeast it can not manufacture its own food, but must find it already made, and so it gets on our food and spoils it—for us. Such plants are never green.

5. Mushrooms, corn smut, wheat rust and tree diseases are known as fungi, because they do not make their own food. They are none of them green.

6. Seaweeds are also nonflowering plants. Some of them are very large and some are beautiful in color.

7. Mosses grow in damp, shady places and often make soft, velvety mats or carpets of green.

8. Ferns grow in damp, shady places, too, and in western Kansas few are found. Nearly every one knows the house ferns, such as the Boston fern. But some plants are called ferns which are not ferns at all; for example, the "asparagus" fern. It has flowers on it, and no real fern has flowers. Real ferns have spores on the back side of the fronds. They are in little groups or dots, and sometimes people take them to be insect eggs.

9. Scouring rushes are found along streams and around ponds in western Kansas. We have heard them called "snake grass." They have telescopically jointed stems, and nothing that looks much like leaves.

4—Nature Study
All the plants of the nonflowering sort reproduce by means of cell division or else by spores, which are tiny cells capable of reproducing the plant. They are more like the pollen of flowering plants than the seed.

We have tried to give, in the preceding items, facts about nonflowering plants. Children will be interested in them and will ask questions about them. What has been given above may help to answer these questions.

Note.—Sometimes when nonflowering plants are mentioned people think of trees and weeds. All trees and weeds, as we usually know them, have flowers and seeds, though the flowers may be quite inconspicuous.

FLOWERING PLANTS.

On the following page we give a few of the prominent flowering plant families, with a few of their characteristics and familiar members. You may be surprised to see what plants are near relatives. Look them through carefully.

Other plant families which are familiar are:

| Violet. | Iris. | Nettle. |
| Mallow. | Morning-glory | Vine (grape). |
| Geranium. | (convolvulus). | Walnut. |
| Cactus. | Poppy. | Willow. |
| Milkweed. | Spurge (has milky juice). | Primrose. |
| Pink. | Snow-on-the-mountain. | Vervain (verbena). |
| Amaryllis. | | Castor bean. |

There are something like 145 flowering plant families, but those which are here named contain a large majority of familiar plants, including weeds, crops, trees, fruits and flowers.

Who would think, to look at them, that a radish, a cabbage and a turnip were closely related? And yet if one will taste the heart of a cabbage, a piece of turnip and fairly mild radish the resemblance in taste is easily recognized.

Insects readily recognize relations. For instance, the potato beetle will eat the leaves of a buffalobur as readily as those of a potato, but we never have seen them eating the leaves of a plant belonging to any other family.

A certain swallow-tail butterfly lays her eggs on parsnip leaves if she can find them. Her next choice is parsley and her next is celery, all members of the same family.

There is not room in this bulletin to go further into details, but we trust that the suggestions made will lead to close observation of plants and an attempt to learn to recognize them and call them by name whenever and wherever they may be met.
|-------------|-------------|----------------------|---------|---------|------|-----------|------|------------|------|-------|
V. Earth and Star Studies.

1. Star Studies.

There are certain studies which are of value not so much for their information or the facts as for the conception of things which they give. Star study is one of this sort.

The Moon.

1. What is the moon, anyway? Are there any other moons of which we know?
2. What causes a “new” moon? Find the “Gibson Girl” in the moon. What is she really?
3. Draw three circles representing the comparative size of the earth, sun and moon. Also place them so as to show their relative distances apart. (Nature Study and Arithmetic.)
4. Show by circles the relative positions of earth, sun and moon when the moon is new; when full.
5. What causes an eclipse of the moon? of the sun?

The Planets.

1. Revolving around the sun are at least eight planets, of which the earth is one. They are, in the order of their distance from the sun: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune.
2. Which is the largest of these planets? the smallest? (See “Planets” in Webster’s New International Dictionary.)
3. How long is a year on Jupiter? What do we mean by a “year”?
4. Is a day the same length on all these planets?
5. The earth is about 92,000,000 miles from the sun. Neptune is 30 times as far. How many miles would that be?
6. The other planets are revolving around the sun just as the earth is, and so they appear to us to move around among the stars. When a planet is visible in the sky in the evening we call it an “evening star.” When it is visible in the morning sky we call it a “morning star.” (See an almanac for the evening and morning stars, as well as for the eclipses for the year. An advertising almanac will do.)

The “Fixed” Stars.

1. The other stars in the heavens appear to be fixed in place. They are really moving, but are so far away that we can not see any relative change in their positions in a lifetime.
2. They are probably suns, the centers of other solar systems with planets revolving around them too.
3. Some of them are so far away that it takes their light 100 years to reach us. Some may have disappeared years ago, but we still see them because their light is just reaching us.
4. Why do stars “twinkle”?

Constellations.

1. Constellations are stars so grouped together (not in reality but appearing so to us) that figures have been imagined in the heavens. Usually the figures are rather “far fetched,” but the names have become permanent and these groups of stars are universally known by these names.
2. The Big Dipper and the Little Dipper, each a part of a larger group called the Big Bear and Little Bear, respectively, are the most easily recognized constellations.

3. The North Star should be located with reference to the two dippers.

4. Orion is perhaps the most prominent of all the other constellations. It is visible in the winter. In fact, the brightest constellations are mostly visible in the winter.

5. The evenings are dark earlier in the winter, which also makes that season the best for star study.

6. The Scientific American (a weekly magazine), in its number nearest the first of the month, gives a star map for the month following, from which names of constellations and their positions can be obtained. It also tells of evening and morning stars, eclipses and comets.


2. The Shadow Stick.

Get a smooth inch board about one foot square. Drive a nail about two inches long through the center of it. Place this board on a window sill or table where it will be level and where the sun will shine on it as much of the day as possible. It should be so placed that if moved it can be replaced in exactly the same spot.

At each hour of the day place a dot at the end of the shadow made by the nail on the board. (A piece of paper can be used on which to keep this record, by slipping it on over the nail and thumb-tacking it down until the record is complete.) Draw a continuous line through these dots. What shape is it?

Make another record on the same sheet of paper a week or two later. Is it the same as the first record? Continue the records from time to time throughout the year. What changes take place? Why?

1. On what date are the shadows longest? shortest? Why?

2. At different times of the year will the shadow always be in the same straight line at the same hour of the day? Explain.

3. Is the shadow straight north and south at noon? Explain.

4. If it is not straight north and south at noon, by the clock, at what time will it be? What is the difference between sun time and standard time in your locality?

5. Can you tell the time of day by the shadow stick?

The above questions are for the teacher rather than for the pupils. Let the children do the marking; let them ask their own questions, and, as far as possible, discover their own answers. The teacher is merely an unobtrusive guide and supervisor.

The shadow stick can be made by a boy in a few minutes’ time. He will be tickled at the chance to do something.

The shadow stick is the means of the beginning of the observations of the motions of the earth and of the seasons.

Longitude and time is one of the bugaboos of geography. The first thing that children know or hear of the subject is usually the name, and it ought to be about the last thing that they hear. Gradually, month by month and year by year, they can observe the motions of the earth in a simple and natural way, and by the time they are ready for the specific subject they already have a good, simple conception of it.

The shadow stick can be the beginning of many questions and much real thinking. The writer guarantees that it will even make a teacher think, sometimes. But never mind that; it’s all in the game. Try it.

A SUN DIAL.

The sun dial is really a modified shadow stick. Some of the boys may wish to make one. The “Boy Scout Handbook” tells how to make it.

Keep a record of the weather, somewhat as follows:

<table>
<thead>
<tr>
<th>DATE</th>
<th>Out-of-doors temperature at 8:50 a.m.</th>
<th>Wind direction, 8:50 a.m.</th>
<th>Clouds, kind.</th>
<th>Cloudiness, amount.</th>
<th>Rainfall, inches.</th>
<th>Snowfall, inches.</th>
<th>Frost.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sept. 1</td>
<td>75° F.</td>
<td>S. W.</td>
<td>Cumulus</td>
<td>Scattering</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Thunder showers in the neighborhood.</td>
</tr>
<tr>
<td>Sept. 2</td>
<td>75° F.</td>
<td>East.</td>
<td>Cumulus</td>
<td>Formed a storm at 4 p.m.</td>
<td>1.25</td>
<td>0</td>
<td>0</td>
<td>Severe lightning.</td>
</tr>
<tr>
<td>Sept. 3</td>
<td>70° F.</td>
<td>West.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td>Cool and pleasant.</td>
</tr>
<tr>
<td>Oct. 25</td>
<td>83° F.</td>
<td>N. W.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td>First frost of season.</td>
</tr>
<tr>
<td>Dec. 9</td>
<td>25° F.</td>
<td>N. E.</td>
<td>Cumulus</td>
<td>Total all day</td>
<td>0</td>
<td>6</td>
<td></td>
<td>First heavy snow of season.</td>
</tr>
<tr>
<td>Dec. 10</td>
<td>—2° F.</td>
<td>N. W.</td>
<td>Clear</td>
<td></td>
<td>0</td>
<td>0</td>
<td></td>
<td>First time below zero.</td>
</tr>
</tbody>
</table>

This weather charting can be kept up daily, including Saturday and Sunday, throughout the year, or for as long as it seems worth while.

This weather tabulation can be used from the middle grades up. It can be preceded in the early grades by learning to recognize cloud forms, wind direction, snowflakes, etc.

In the upper grades and the high school an additional column for barometer readings (if a barometer is available) can be added.

Weather maps can be studied from the seventh grade up. They can be obtained by requesting them from the nearest weather bureau office, as Topeka, Kan., or Kansas City, Mo.

**SUGGESTIONS.**

Let the boys, for busy work (in the lower grades), or for manual training, make a weather vane of the whirling sort.

The boys can also plan and make some sort of arrangement to measure rainfall.

A chart picturing and naming the different cloud forms can be obtained for the asking from the United States Weather Bureau, Department of Agriculture, Washington, D. C. It ought to be in every schoolroom.

Make a study of weather "signs" and superstitions. Some have some basis of fact and some have none.

Follow the weather predictions in patent medicine almanacs to see if they are reliable. (This is an excellent lesson in real investigation, to get the facts in the case rather than mere expressions of opinion. There is a lot of mere expressing of opinions in this world, which leads to useless argument and debate and gets nowhere. Boys and girls might as well learn to get real facts.)


To learn to distinguish the different kinds of minerals and learn how they were formed are the chief purposes of this study.

The story of the origin of coal will lead the children into new fields of thought and will lead to new conceptions of the forces at work in and on the earth.

More suggestions regarding the study of minerals are made under the general heading "Collections."

5. Simple Experiments with Earth Forces and Elements.

The following are simple little experiments, but demonstrate wonderful forces with which we all need to become familiar sooner or later. Children are fascinated with them.
Let the children do most of the question-asking. But it may be wise to ask a question here and there to start them thinking. Try to answer their questions simply and honestly. Some of the forces involved in these simple experiments are not understood by any one.

Such experiments are good for recess periods on stormy days.

The materials needed can mostly be brought by the children. Some boy in the school probably has a magnet, another has a magnifying glass, another has a compass, and perhaps another knows where he can get a tuning fork. Such things as needles, silk handkerchiefs, glass rods, rubber tubing and candles can mostly be brought from homes. All the materials involved would not cost more than a dollar or two. (See a scientific supply company catalogue or a mail-order house catalogue.)

I. MAGNETISM.

1. Touch various kinds of metal with a magnet. What ones are lifted? Explain.
2. Lay a magnet on the table. Put a sheet of paper or a piece of glass (try both) over it. Sprinkle iron filings on the paper or glass and tap the table gently. What happens? Why? (A boy can make a teaspoonful of iron filings in a few minutes by filing an old piece of soft iron with a large file.)
3. Magnetize a needle by rubbing it on one end (only) of the magnet. Rub a little vaseline on the needle. Now carefully place it on the surface of water in a glass or earthen dish (why not metal?). Place it so that it points east and west. What happens? Explain.
4. Will the needle used in the above experiment pick up iron filings? Explain.

II. ELECTRICITY.

(These experiments are best done in cold, dry weather.)
5. Rub a glass rod with a silk handkerchief. Bring the end of the rod near some small bits of tissue paper or burnt matches. What happens? Why?
6. Rub a cat’s fur (in cold weather). What do you see (in the dark)? and hear? What is it? What causes it?
7. Brushing or combing one’s hair often shows static electrical conditions (in cold weather).
8. In cold weather, sitting in a varnished wooden seat and moving around a little will set up a charge of electricity which can be discovered by touching metal or some one else’s ear or nose, first having risen from the seat.
9. Some of the boys may have electrical apparatus which they would be willing to bring to school and demonstrate.

III. LIGHT.

10. Refraction of light: Put a penny or other coin in the bottom of a basin with vertical sides. Stand far enough away from the pan that the coin will be just out of sight. Then gradually pour water into the pan and the coin will appear in sight. What has happened?
11. Hold a straight stick obliquely in water. Why does it look bent?
12. Place a glass prism (any piece of clear glass with angles, such as a pendant from a chandelier or a glass paper weight) in the sunshine so that it will make a colored spot (spectrum) on the wall. What is the cause?
13. Burn a hole in a piece of paper by holding a lens between it and the sun. Explain.
14. Hold a piece of paper edgewise to a lens and let the sunlight shine through the lens so that it will show the shape of the rays of light after they pass through the lens. Why does curved or angular glass change the direction of light? What is meant by the focus of a lens?
IV. SOUND.

(A tuning fork is necessary for these experiments.)

15. Why does a tuning fork sound louder when placed on a table than when vibrating in the hand?

16. Set a tuning fork vibrating, then place it on the end of a yard stick with the other end on the floor. Where does the sound come from? Why?

17. Tie a thread about ten inches long to one prong of a tuning fork and tie the other end to some stationary object. Set the fork vibrating and pull the thread almost straight and watch it. What happens? Explain.

V. AIR.

18. Blow up a paper sack and burst it. Why does it make a noise?

19. Make a paper whirligig by taking a square piece of paper and cutting diagonally from each corner toward the center. Bend alternate corners to the center, and run a pin through them and the center of the paper and then into the end of a stick, and you have a whirligig. Hold it against the wind. What makes it go? What is wind? What makes wind?

20. Make a siphon. Use a rubber tube or a bent glass tube. Place one end in water in a vessel of some kind and the other end out over the edge of the vessel and outside, placing it lower than the surface of the water inside. Suck through the outside end of the tube and start the water flowing. What causes it to continue? When will it stop?

21. Fill a glass with water, cover with paper, and turn upside down without spilling it. Explain.

22. Air and burning: Light a short piece of candle, place it on the table, and then place a bottle or jar over it. How long will it burn? Why does it stop?

23. Breathe into a bottle for a minute or two and then place it over a burning candle. What happens? Why? Suppose one sleeps in a closed room without ventilation?

VI. GRAVITY.

24. Most boys know how to balance a knife by the point of one blade from the edge of a table or desk. What principle does it illustrate?

25. Float a needle, slightly greased with vaseline, on the surface of water. Explain.
VI. General and Miscellaneous Studies.

1. A Nature Diary.

A DIARY of the happenings in nature kept by the whole room, perhaps on the blackboard in the lower grades, and by individuals in the upper grades, is an excellent stimulant to the formation of observational habits. In fact, we know of no better scheme for that purpose.

Spring is the best time for such a diary, though the happenings of any other season may well be recorded in the same way.

The diary may be modified in many ways. In one rural schoolroom the writer saw a border of ten-inch circles along the top of the blackboard, each circle representing a month. Within these circles pictures were pasted and drawings were made representing the happenings of the respective months as they occurred. The result was attractive and effective. A vegetable garden diary is another valuable form.

The following consists of selected portions of a diary kept in a certain school during the spring of 1917.

**NATURE DIARY (FOR SPRING).**

Feb. 9.—Saw three robins.
Feb. 21.—Saw meadowlarks.
Feb. 22.—Saw a ground squirrel.
Mar. 10.—Saw a chickadee and a pair of redbirds.
Mar. 12.—First lightning and thunder.
Mar. 13.—A little snow.
Mar. 16.—Dust storm.
Mar. 22.—Planted potatoes.
Mar. 25.—Elm flower buds open.
Mar. 26.—Saw sparrows gathering straws.
Mar. 28.—Lilacs leafing out.
Mar. 30.—Found a frog. Saw a dragonfly.
Mar. 31.—Found a dandelion blossom.

April 3.—Found two clusters of frog's eggs in the creek. Put them in a jar of creek water with a little mud and organic matter in it.

April 15.—Frost and freeze. Easter Sunday. Beautiful day.
April 16.—Frog's eggs are hatched.
April 17.—Half inch of rain.
April 23.—Collected staminate and pistillate blossoms of box elder, ash, cottonwood and hackberry.

April 27, 28, 29.—Rain.

May 1.—Blue jays have arrived.
May 2.—Baltimore oriole, brown thrashers, Maryland yellow throat and warblers seen.
May 3 and 4.—Saw towhees, Le Conte sparrows, olive-backed thrush, white-crowned sparrow, king birds and cardinal.
May 5.—Found violets. Ninth day of cold, cloudy weather.
May 7.—Frost last night.
May 11.—Wrens building. Saw bull snake. Saw turtle dove's nest with two eggs in it.
May 23.—Light frost in spots. Unusually late for a frost.
June 5.—Thunder storm and hail during the night. Heard chorus of toads for the first time this spring; rather late on account of cool weather.
2. An Aquarium.

If a teacher does nothing more, in the way of nature study, than to bring to the schoolroom objects of interest in nature, she has done much. In fact we are not sure but that early education should consist largely in leaving in childhood's way those things which arouse the latent natural interests and instincts and which become stimulators of interest, effort and questions. At any rate we know that an aquarium in a schoolroom is worth while. It might well be placed first among schoolroom appliances for nature study.

There are places where it may seem hard to find occupants for an aquarium, but in this day of automobiles it ought not to be difficult to obtain materials. In fact, if the aquarium is at hand we would be willing to guarantee that the boys will find occupants for it, such as native fishes, turtles, crayfish, clams, tadpoles, water insects, leeches, frogs and water plants.

There are many schoolhouses which are not kept warm overnight or over the week end, and an aquarium can not be kept through the winter. This fact, however, will not deter any teacher who really wants an aquarium from keeping one during the weeks preceding and following winter.

**CARE OF AN AQUARIUM.**

Water plants in an aquarium will increase its success many times over. Why? Change the water occasionally. Spread gravel over the bottom. Also include clam shells or rocks under which the occupants may hide.

In feeding fish be sure not to leave any uneaten food in the aquarium. Its decay will soon kill the fish. Bread crumbs and flies for sunfish and minnows; worms and small pieces of meat for catfish, turtles and salamanders make good food. Don't feed too much.

Keep the aquarium where it will get the sunshine through a part of the day, but provide some shade at the same time.

Some city water, when first drawn, liberates air. This gathers on the fish, and they wear themselves out trying to stay down. Let such water stand a few hours before using.

Tadpoles prefer the kind of water they were living in when captured, and with mud and organic matter in it.
**HOW TO MAKE AN AQUARIUM.**

The aquarium described below can be made by boys who are fairly accurate and experienced in handling tools. The materials are obtainable anywhere. The size is convenient, though of course it may be changed if desired. Altogether it is the best homemade aquarium of which we know.

**MATERIALS.**

Wood: White pine, cypress, spruce, cedar, or even poplar or basswood.

Glass: Six pieces, 8 by 10 inches.

Screws: Six slender 2¼ inch, and three dozen 1½-inch screws.

Orange shellac: Half a pint will be plenty. It is obtainable at paint stores, garages, blacksmith shops and carpenter shops.

Cost: The materials will cost about one dollar.

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**CONSTRUCTION.**

1. Base: On the under side of the base there are three grooves or kerfs and two cleats, to prevent warping. The cleats also serve as legs.

2. Posts and sills: Made about one inch square. Each post and sill has one or two (in posts) grooves into which the glass slides. The grooves can be made with a widely
set rip saw following a tacked guide. The grooves are \( \frac{3}{8} \) inch deep and a trifle wider than the thickness of the glass.

3. Top: The top strips are not grooved. They are put on after everything else is complete.

4. Before each post and sill is put in place a good coating of thick orange shellac should be put on all connecting surfaces. Then before the shellac is dry put in the screws, previously boring a hole the size of the screw shank for each.

5. Just before the glass is put in put thick orange shellac in the grooves.

6. After everything is in place go around all joints with a pointed brush, putting the shellac on thickly but evenly. Paint all inside surfaces with shellac or varnish.

7. Paint or varnish the outside woodwork in any way desired.

**PRECAUTIONS.**

1. Allow the shellac to dry thoroughly before putting water into the aquarium. Then test it by filling it gradually.

2. Make every piece for the aquarium accurately, so that all joints will be tight.

3. Be sure to make the grooves for the glass evenly. Otherwise breaks will occur.

4. If the shellac is not thick enough allow it to evaporate somewhat before using it.

Note.—The cuts and suggestions for this aquarium are used by permission of the Curtis Publishing Company, and were taken from the *Country Gentleman* for December 25, 1915.

3. A Nature Scrapbook.

Papers and magazines are constantly publishing items and pictures of nature interest. Why not make a scrapbook of such items and pictures?

The fact that such a scrapbook is being made in a schoolroom will cause pupils to be alert for interesting materials.

Care needs to be taken that children in their zeal do not clip from permanently valuable magazines.

Classify the pictures and clippings according to some plan. It may be well to gather the clippings and put them into envelopes for a few weeks before starting the scrapbook, so that some idea of the items and their assortment can be made first.

A large proportion of the items may be found to be on birds and insects. It would be wise to classify the insect items. A large number of these may be on flies, for example. Put them all together in one part of the book.


**THE COLLECTING INSTINCT.**

The desire to collect is instinctive with childhood. The instinct might just as well be unobtrusively guided along lines of future practical value as along those of little or no future value. The interest of childhood is more in the collecting than in the thing collected. A boy will be just as much interested in making a collection of weed seeds as of tobacco tags, and probably the former will have more to do with his future efficiency than the latter. Therefore, a little guidance may make all the difference between a well-used or a wasted instinct.

The collecting instinct is just one of the natural interests of childhood of which we take advantage for educational purposes. In fact, we are not sure but that that is just the mission of education, namely, to guide the instincts of childhood into the highest efficiency rather than letting them follow the hit-or-miss choice of circumstance.

And so we have listed, in the "Tabulation of Nature Study by Grades and Topics," some things which can be used to guide and develop this worth-while instinct. We also here append further suggestions regarding such collections.
WEED SEEDS.

Following is a partial list of weed seeds which can be collected in autumn:

- Pigweed (red root)
- Sunflower
- Lamb's quarter
- Giant ragweed
- Small ragweed
- Vining buckwheat (black bindweed)
- Dock
- Smartweed
- Knotweed
- Horseweed
- Sand bur (grass)
- Foxtail
- Milkweed
- Cocklebur
- Devil's claw
- Wild lettuce
- Yucca (soap weed)
- Ironweed
- Russian thistle
- Buffalo bur
- Tall verbena
- Spanish needle
- Grasses of all kinds
- Prickly poppy
- Dodder
- Loco
- Wild sage mint
- Tall primrose
- Composite flowers of many kinds
- Loco
- Yucca (soap weed)
- Wild sage mint
- Tall primrose
- Composite flowers of many kinds

These seeds can be displayed in small bottles, or, in the upper grades and in high school, seed cases can be made as directed on another page in this bulletin.

For several reasons, a weed-seed collection is worth making. The following questions and suggestions will indicate some of them.

WEED SEED STUDY.

1. Do you notice seeds from different weeds that look alike? What ones, for example? How do they happen to be alike.
2. Compare dock and vining buckwheat seeds; wild sunflower and tame sunflower seeds; wild gourd and squash, pumpkin, watermelon and cucumber seeds; wild lettuce and tame lettuce seeds.
3. What kinds of weed seed may get mixed with crop seeds and cause trouble?
4. What weeds are particularly bad in gardens and on the farm?
5. Often one may identify weeds by their seeds more easily than in any other way.
6. Dodder and wild morning-glory, or bindweed, are two of our hardest weeds to eradicate when once started, and it pays to be able to recognize their seeds.
7. One can learn to recognize relatives among plants by their seeds, as suggested in Nos. 1 and 2.
8. Children will enjoy contests to see who can recognize the most weed seeds.

VEGETABLE GARDEN AND FIELD CROP SEEDS.

1. In the same way as with weed seeds, vegetable and crop seeds may be collected and recognized.
2. Notice how much alike the seeds of radish, mustard, cabbage and turnip look. Why?
3. In the same way compare tomato, tobacco, peppers, egg plant. They all belong to the potato (or nightshade) family.
4. Compare the seeds of alfalfa, clover (of various kinds), beans, etc.

A SEED COLLECTION CASE.

The seed case pictured herein is made as follows:

MATERIALS.

1. Wall board ("Beaver," "Upson," etc.), 5 by 8 inches, or any other size as preferred. Obtainable at lumber yards.
2. Glass: Two pieces, each 5 by 8 inches, one for front and one for back, or—
3. Thin cardboard in place of the glass for back.
4. Cloth binding tape.

5—Nature Study
CONSTRUCTION.

The holes in the piece of wall board are usually three-fourths inch in diameter and the centers one inch apart. They are made with a brace and bit. The bit must be sharp so as to make a clean-cut hole. Put the piece of wall board between two pieces of inch board and put in a vise. Cut the holes half way through from one side and then from the other side.

Or, several pieces of wall board may have the holes cut through at once by putting them between inch boards and boring with brace and bit through boards and all.

When the holes are made, glue one piece of glass, or else a piece of thin cardboard, such as is used for window advertising cards, on one side for the back. While this is drying keep it flat under a weight. Select the seeds to be put into it. Then write the names of the seeds under the holes into which they are to go. Next put in the seeds.

To keep the smaller seeds from straying from their compartments the upper glass cover must now be put on very tightly and securely. Lay it on, place the case between two boards and then in a vice, or in a clamp, leaving one edge free for the tape. Cut the tape the proper length, run it through water so that it is wet all over (both sides). Shake the surplus water off and put the tape on, evenly. Allow it to dry and then proceed with the other edges in the same way.

WEEDS AND WILD FLOWERS.

The following is a list of some of the most common weeds and wild flowers which children might well learn to recognize:

- Amaranth, prostrate.
- Artichoke, false.
- Buckwheat, vining.
- Bindweed (wild morning-glory).
- Bull thistle.
- Bull nettle.
- Buffalo pea.
- Buffalo bur.
- Cactus (two kinds).
- Chickweed.
- Clover.
- Cocklebur.
- Cheeses (mallow).
- Canada thistle.
- Carpet weed.
- Daisy.
- Dandelion (two kinds).
- Deadly nightshade.
- Devil's claw (unicorn plant).
- Dock.
- Dodder.
- Dog fennel.
Weed, wild flower and tree leaf collections.

Weeds and wild flowers as well as tree leaves can be pressed and dried between sheets of blotting paper, under books as weights. Their positions on the blotting paper should be changed to dry places every day for a few days to avoid molding. Leave under pressure for a week or ten days, at least.

Weeds, flowers and leaves can be mounted on cotton between pieces of glass, or between glass in front and pasteboard behind, and bound with tape, like the seed cases. This makes an attractive and permanent display case for such collections. Tree seeds and other seed vessels, if not too thick or bulky, can be preserved in the same way.

Seeds and seed-vessel transportation.

Seeds and seed vessels with wings, hooks, parachutes and other special means of transportation make interesting and instructive collections. Examine the spines of a cocklebur closely. Use a magnifier.

Fungi.

Make collections of tree diseases and other fungi. Corn smut and wheat smut and rust may be brought temporarily, and then should be destroyed.

Tree twigs.

Mount and label tree twigs on a piece of cardboard. The children will enjoy testing themselves on the naming of trees by their twigs.

Bark and wood samples.

Collect samples of as many kinds of wood and bark as possible. Cut in as uniform a shape and size as possible. Label.

Can you recognize oak, pine, cedar, maple, elm, ash and hickory, for example, when you see them?

Insect collections.

We doubt the wisdom of encouraging in any way or suggesting to children the killing of living things. The farthest that we would go in insect collecting would be to have on hand in the schoolroom a collection of type and common insects, that children might more closely see them and learn to recognize them. Beyond this we would not go.
Insects may be killed by pouring gasoline on them (their “noses” are along the sides of the abdomen). A pin can be put through the thorax (the middle of the three divisions of the body). The insects may be put in cigar or other boxes, in the bottom of which have been glued corn pith, cork, or other soft material into which the pins may be stuck.

The wings of butterflies, moths and a few other insects need to be kept spread out in the desired position for a few days before mounting in the box.

**INSECT WORK.**

Interesting and profitable collections of insect work, such as wood borings and carvings, insect galls on leaves and stems of plants, cocoons, wasp nests, and pictures of insect effects on crops, can be made.

Try to find out what insects have done the work in each particular case; also find the preventives and the remedies against insect destruction in each case.

**SOIL AND MINERAL SAMPLES.**

Make a collection of clay, loam, sand and other soil samples in their various grades. Use small bottles to put them in. Label. Children might just as well learn to recognize kinds of soil by making the samples familiar objects in the schoolroom as not.

Gather samples of limestone, sandstone, granite, marble and shale in their various forms. Call attention to the fact that soil comes from rock.

From what kind of rock does sand come? clay? What makes soil black or dark?

The children can get marble and granite samples from the monument works in their town, or the nearest town where there is such a shop.

Also gather samples of ores, as iron, copper, zinc and lead; likewise of coal.

It is from the soil that all our food and raiment and building materials come. Is’n’t it worth while for children to begin to become familiar with it? It is an easy matter to gather the materials; it seems like a very simple, common thing to have them in the schoolroom; but just having them there even, makes no small difference in a child’s final conception and understanding of things.
FOSSILS.

It is worth while to begin a collection of fossils for the school or schoolroom. The questions which arise in a child's mind as to where those animals (or plants) came from, how they got there and how long ago they were alive, are the beginnings of broad conceptions of the make-up and evolution of the earth, and the universe, for that matter.

MISCELLANEOUS.

Collections of local shells, such as clam (mussel) and snail shells can well be made. Compare them with fossil shells found in the rocks. Shell collections from the seashore can be made also, but local shells are more important at first. Geography should begin at home.

When bones and teeth of animals are found, try to name the animal from which they came. Also try to locate the bone or tooth in its proper place in the skeleton or jaw, respectively.

Collecting the various things mentioned is the beginning of very real geography. Give the children the advantage of it.

NATURE STUDY IN THE WATER.


Theoretically, excursions are ideal for nature study and should be made often. Practically, the teacher finds a number of difficulties in the way. Theoretically, children should live out of doors. Practically, certain artificial conditions, which have come with “civilized” living, keep them indoors more than out. Theoretically, we should go to school out of doors. Practically, books, blackboards, “nice” clothes and “convenience” keep us inside.

However, the more nearly we can approximate natural conditions, and still retain the advantages which have come with “civilization,” the better off we will be. Open-air schools are springing up, especially in the cities. Teachers are learning to use the out-of-doors through play and nature study, and even for the usual school routine occasionally.

The desire to have excursions, some forethought and a little gumption will obviate most difficulties.
The chief difficulty which teachers fear that they will meet is that "the children will run wild." The following suggestions should help to remove the difficulties:

1. Children need to become accustomed to new things gradually.
2. The children should have become interested in some definite items of nature study before any excursions are made. Then they will have definite interests on excursions.
3. Let the first excursions be short ones, taken with very definite objects in view, or, as merely incidental and not preconceived, at some recess or noon period.
4. The first excursions may very well be taken at noon (in rural schools, where children bring their lunches) or at a recess period, if the children wish.
5. Have definite plans in view before starting on an excursion. The children should know what they are looking for. The teacher might well go over the ground herself beforehand.
6. The trip should have been planned long enough beforehand that the children can have ready any collecting bottles or other materials necessary for the trip.
7. Beware of the notebook fad. If there is something worth taking notebooks for, all right, take them. But don't make any one keep a notebook just for the sake of keeping it.
8. If the number of children in your room is large you may wish help on an excursion. You can find ways of getting it if you really try.
9. While excursions should not be used as a reward for good behavior, nor the loss of the privilege as a penalty, yet unconsciously children will learn to feel that excursions are dependent upon thoughtfulness on their part.
10. An excursion may take the form of a picnic, in which case the purpose may be the picnic, and the nature study purely incidental to it, or vice versa.
11. Finally, remember that children are built to romp and play and have a good time. Just use common sense—which means, understand and sympathize with childhood and act accordingly.

NATURE STUDY EXCURSION OBJECTIVES.

AUTUMN.

1. To collect weed seed. Take small envelopes in which to collect the seed and on which to write names.
2. To learn to recognize weeds and wild flowers, and perhaps to make a pressed collection for the schoolroom.
3. To learn to recognize trees by their leaves and to collect samples of tree leaves. (Have a contest.)
4. To observe and learn to recognize insects.
5. To observe and learn to recognize birds.
6. To visit a stream or pond and observe its inhabitants and to gather materials for the aquarium (which may be merely a jar).
7. To collect fungi, insect work, minerals, fossils.
8. To observe and collect seed and fruit transportation. Examples: Seeds and seed vessels with hooks, wings, etc.

WINTER.

1. To observe snowflakes. How many points has a snowflake? Do they all have the same number?
2. To count birds' nests in the trees and estimate the number of birds in the town (if in town) during the preceding summer.
3. To observe the stars (in the evening), and to hear a story of some one star, planet or constellation, or of the moon.
4. To observe and learn to recognize trees by their twigs (have a contest for this purpose).
5. Same for bark.
6. To study evergreen trees.
7. To find animal tracks in the snow.
8. To observe the winter birds.

**SPRING.**
1. To observe the tree buds expand and burst and blossom.
2. To see elm, ash, box elder and other shade tree blossoms.
3. To observe the returning birds.
4. To gather materials for the aquarium.
5. To observe and name spring flowers.
6. To observe ants at work in an ant hill.

The teacher will think of many more objectives for excursions.

6. **Special Days.**

There are a few particular days during the school year which may be fitted into the nature-study work.

**THANKSGIVING.**

Autumn studies of seeds, fruits, crops and autumn leaves may culminate in a Thanksgiving program.

**CHRISTMAS.**

The approach of Christmas may be made occasion for the observation and study of evergreen trees, mistletoe and holly. Whence does each come? How do they grow?

**EASTER.**

Easter may be the center about which cluster the ideas of the awakening of living things—the beginning of growth following winter sleep, the germination of seeds, and the blooming of flowers.

**DAYS OF THE WEEK.**

Where do the days of the week get their names? For example, Sunday? Monday? Saturday? How many people have ever stopped to think of the significance of the names of the days of the week? There are myths connected with these names which children would enjoy.

**NAMES OF THE MONTHS.**

Likewise the significance of the names of the months are of interest, and as the first day of each month comes around it may be made the occasion for a little history as well as myth study. Why was the year divided into twelve months? What does the word month, itself, mean?

**ARBOR DAY AND BIRD DAY.**

Arbor and Bird Day is particularly a nature-study day. Trees shelter birds, and the birds destroy the insects which would otherwise destroy the trees. It has been stated by authorities that not a tree would remain if all the birds were to be destroyed. On the other hand, few birds remain where there are no trees. The two are mutually beneficial to each other, and in turn to mankind. Hence the two are inseparable, and a day near the middle of April is appropriately set aside by the governor for the planting of trees, shrubs and vines and placing of bird houses and baths.

We suggest the following plans for planting:

1. Plan to plant at least two trees on the school grounds each year. But plant those two right. Make definite arrangements for their care for at least one year. It is better to plant one tree and care for it than a dozen and allow them to go without care.
2. In digging holes for trees dig them at least three feet in diameter, two feet deep, and spade up the bottom.

3. Dig the holes and fill them with water at least once before the day of planting. Then use less water at the time the tree is set out, so as not to puddle the soil.

4. Never allow the roots of a tree to be exposed to dry air or sunshine for even a few seconds. Keep them covered with wet gunny-sacking or other material.

5. Keep the ground cultivated around the tree. Water it thoroughly once a week.

6. Let each child have something to do with the preparations. Let each have his turn at caring for the trees after they are planted.

A slogan: Trees in every school and home yard in Western Kansas.

As to the birds we suggest the following:

1. Bird houses (preferably wren houses in this part of the state) should have been made during late winter or early spring. Let each child put one up at his or her home on Arbor and Bird Day. (See directions elsewhere in this bulletin for making bird houses.)

2. Make a bird bath in the school yard and others at the homes of the children. (See directions for making them elsewhere in this bulletin.)


Nature study, in its fullest sense, is not a subject to be added to the curriculum; it is not a thing to be correlated with the other subjects of the curriculum. It is a way; it is an attitude of mind; it is an attempt to make education fit childhood; it is an attempt to provide childhood with what it wants to know, when it wants to know it. It has come to be a name of educational significance rather than a subject.

Much is said nowadays about correlating nature study with other subjects. It is n't a matter of correlation; it is a matter of teaching first-hand realities, whatever the subject, at that particular moment when there has been aroused in a boy's or a girl's mind a question about or a problem connected with that subject. To talk about correlating nature study with geography, language work, reading, arithmetic and art is to misconceive the purpose and function of all of these subjects.

NATURE STUDY AND GEOGRAPHY.

Physical geography, for childhood, is a study of nature. Or, to reverse it, the study of the earth and its inhabitants (and that is "nature") we call "geography." And so it matters little what we name the subject, or whether we name it at all, provided it is real to childhood. The study of birds and insects and animals in general, of trees, seeds, fruits and plants in general, of stars, and weather and soil and minerals, right here at home, is geography.

There is time enough to study the physical geography of China or Africa after we know our own, and when occasion, and thereby interest, arises.

See the article on the shadow stick elsewhere in this bulletin.

NATURE STUDY AND LANGUAGE.

Language, spoken and written, along with art and arithmetic (both of which are forms of expression), are man-made tools contrived and developed for man's convenience and time-saving; and excellent tools they are, well used. They were made to communicate, one to another, man's experiences in and with the world in which he lives; and that world we sometimes call, for convenience, "nature."

Good literature is a tool well used.

The boy who, in self-forgetfulness, describes to the rest of the school the peculiar antics of some blue jays on the ridge pole of the barn roof, which he has seen the day before, is doing the finest kind of language work—first, and most important, because he
is describing something in which he is really interested and in which he wants others to be; and second, because it is spontaneous and natural.

For this reason the nature-study way of doing things applies to language work particularly. It provides the natural materials for self-expression.

**NATURE STUDY AND READING.**

Suppose that the above-mentioned boy, because of this sudden interest in blue jays, wishes to find out more about them and their actions. He searches through books and magazines, and then the next day he reports to the teacher and to the other pupils what he has found, either in his own words, which is so much the better, or in the words of the author. Do you think he will give it in a sing-song way? What a difference in interest on the part of the whole school and in naturalness of expression it would make if all reading lessons could be like that!

**NATURE STUDY AND ARITHMETIC.**

Arithmetic is a tool to be used in the expression of our quantitative experiences. All our ideas of space, time, weight and temperature must come through our senses. The accuracy of those ideas is dependent, not first upon units of measurement nor tables of the same (that is the expression side of it), but upon sense training. Did you ever have a teacher who gave you opportunity to estimate distances or to guess the weight of a book, or estimate time while she held her watch? I never did. And yet those would be fundamental conceptions. Usually we put the cart before the horse and begin learning names and tables before we know the things the names are supposed to designate. Our senses should first supply the materials for our later mathematical studies.

And so the nature study way may even apply to arithmetic.

**NATURE STUDY AND ART.**

All our ideas of color, form, odor, sound, rhythm and harmony have come through our senses. In other words, the fundamental materials for drawing, painting, sculpture and music must come through the senses. Imagination itself is proficient in proportion as it has a fund of accurate, sensory materials upon which to build.

Our sense of the beautiful is dependent upon a wide range of observation and a keen sense of proportion, balance and harmony.

And thus here again we find that childhood's appetite for sensory knowledge is but nature's way of educating.

**8. Gardening, Poultry Raising and Pig Raising.**

At a certain age boys and girls begin to desire the ownership of live property. They want something of their very own which they can raise. Along with the longing for ownership there may come the trading and buying and selling instinct. The desire to own rabbits and white mice is an outcropping of this instinct. Of course there is involved in it the ever-present interest in living things.

These instincts are all to be encouraged and developed. To the boy who owns a pig there immediately arise problems of feeding it. How can he grow the biggest, finest pig? These problems give him a sort of education that sticks, because it is real, very real, to him.

The reading of literature may take on a very real form. He gets a government bulletin on pig raising, and if he can't read it he will find some one who can. He becomes absorbed in it. That is real reading.

He keeps a record of his feeding and of his expenses. That is real arithmetic and bookkeeping, because it is important in his business.

And so whatever a teacher can do to encourage and promote these things may well be done. It will pay in terms of boys and girls.
VII. Nature Study References and Materials.


Nature Study requires no apparatus. Its very attitude makes apparatus seem almost out of place; but there are one or two helps.

Magnifying Glass.

We do not believe that children should look at objects through a compound microscope. Their eyes are not yet ready for such close work. But a magnifying glass or two may very well be kept in the school room and used by the children as they find opportunity. Good magnifiers can be bought for from 25 to 50 cents.

Children may well look at such things as a pin point, a thread, a pencil or pen mark on paper, cloth, skin, soil and other familiar objects. Then, as occasion offers, examine flies, mosquitoes, feathers, stones, parts of plants, and snow crystals.

Magnet.

A magnet may well be kept in the school room too. The children through play with it and questions which they themselves ask, will gradually gain conceptions of wonderful world forces.

Compass.

A compass is a school room accessory also worth having around. Keep the compass and magnet away from one another, except that they can be brought near enough together to show how the magnet will hold the compass needle in one direction just as the earth will. How does the earth do it?

Field Glasses.

A pair of field glasses will be valuable for bird study.

WHERE TO OBTAIN SUCH MATERIALS.

Materials such as those listed on this page can be obtained from scientific supply houses such as the Central Scientific Co., Chicago, and most of them from mail-order houses if not in local stores.

2. Books Valuable to Teachers of Nature Study.

Out of the many good books relating to nature study and its various phases we have selected only one or two of the most usable under each topic, feeling that the teacher would prefer to have a brief list chosen from some one’s experience than to have a long list from which to choose, in inexperience.

The great out-of-doors is the chief textbook and should be used most of the time, for her information is all first-hand and absolutely authoritative. But not every one can read it at first sight. The following references are merely aids to be used in learning to read the original. But they are all second-hand. Use them as such.

Nature Study in General—References.

of material on plants, insects, birds, weather, stars, and all the other topics of interest in nature study. We suggest this as book number one for a teacher's library.


**Boy Scout Handbook.** Doubleday, Page & Co., Garden City, N. Y. One of the best pedagogical books published, though not written as such. It is full of nature study materials of the most usable sort. Costs about 30 cents.

**Tree References.**


**Bird References.**

**Pocket Bird Guides.** Doubleday, Page & Co., Garden City, N. Y. $1 to $1.25 each.
1. Land Birds East of the Rockies. By C. A. Reed.
2. Water and Game Birds. C. A. Reed.
3. Western Bird Guide. C. A. Reed. Land and water birds in the Rockies and west to the Pacific coast.

**Insect References.**

**Pocket Butterfly Guide.** Pocket edition like the above bird guides, and published by the same company at about the same price.


**Note.**—The above manuals contain the illustrations in colors. The last two contain pictures and common and scientific names and nothing else. Children, as well as grown folks, usually ask first for the names of things and the above booklets are good for that purpose.


**American Insects.** Kellogg. Henry Holt & Co.

**Note.**—The two above-mentioned books are authorities on insects in general.

**Wild Flowers and Weeds—References.**

The writer knows of no book of wild flowers and weeds which fits western Kansas. Hence we recommend no books on this subject.

**Star Study References.**

**Constellation Chart.** A map of the position of the stars for each month of the year. Can be obtained for 10 cents from Popular Astronomy, Northfield, Minn.

**Mrs. Comstock’s Handbook of Nature Study.** Contains excellent material for star study. (See “Nature Study in General—References.”)


The Nature Study Review. $1 per year. 9 numbers, Ithaca, N. Y. A good help for teachers of nature study.

National Geographic Magazine. Published by the National Geographic Society, Washington, D. C. $2.50 per year ($2 if you join the society). An excellent magazine for teachers to have.


Government bulletins are published by different bureaus. But what are known as the "Farmers' Bulletins" probably include the largest number of interest to elementary school teachers. There are three ways to obtain these bulletins:

1. A certain number are set aside and kept for distribution by the Department of Agriculture. They can be obtained free, as long as this first edition lasts, by writing the department.

2. A certain quota is given to each representative and senator in Congress, from whom they can be obtained free as long as they last. This is the surest way to obtain them free.

3. Congress makes an appropriation for the first edition of each bulletin, and they are distributed free as indicated above. But after this first edition is exhausted future editions are printed, but a small fee is charged for each copy. They are then obtainable by sending the proper fee to the Superintendent of Documents, Washington, D. C. A price list can be obtained by writing to the same place. It is worth obtaining.

SUGGESTIONS.

If you do not know what bulletins are published on any particular subject, write your congressman and ask him to have the bulletin on that subject sent to you; or write the department concerned.

The government publishes bulletins on almost every subject imaginable. A list of subjects on which bulletins are published can be obtained by writing to the Superintendent of Documents, Washington, D. C.

Learn to make use of the government bulletins. It is worth while.

The following are a few Farmers' Bulletins which may be of interest to teachers in connection with nature study:

FARMERS' BULLETINS.

Plants.

<table>
<thead>
<tr>
<th>No. of bulletin</th>
<th>Name of bulletin</th>
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<tbody>
<tr>
<td>86</td>
<td>Thirty Poisonous Plants of the United States.</td>
</tr>
<tr>
<td>408</td>
<td>School Exercises in Plant Propagation.</td>
</tr>
<tr>
<td>368</td>
<td>Bindweed or Wild Morning-glory.</td>
</tr>
<tr>
<td>31</td>
<td>(Contains a table of 100 kinds of weeds.)</td>
</tr>
<tr>
<td>188</td>
<td>Weeds Used in Medicine. (Worth having to see how many of our common weeds are used in medicine.)</td>
</tr>
<tr>
<td>586</td>
<td>Collection and Preservation of Plant Materials for Use in Agriculture. ( Tells how to collect and press plants.)</td>
</tr>
</tbody>
</table>

Birds.

<table>
<thead>
<tr>
<th>No. of bulletin</th>
<th>Name of bulletin</th>
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<tbody>
<tr>
<td>506</td>
<td>Food of Some Well-known Birds of Forest, Farm and Garden.</td>
</tr>
<tr>
<td>(A good bulletin.)</td>
<td></td>
</tr>
<tr>
<td>513</td>
<td>Fifty Common Birds of Farm and Orchard. (Colored pictures of birds. Purchasable from the Superintendent of Documents, Washington, D. C., for 15 cents.)</td>
</tr>
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<td>No. of bulletin.</td>
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<tr>
<td>609</td>
<td>Bird Houses and How to Build Them.</td>
</tr>
<tr>
<td>456</td>
<td>Grosbeaks and Their Value to Agriculture.</td>
</tr>
<tr>
<td>383</td>
<td>The English Sparrow; Its Economic Relations.</td>
</tr>
<tr>
<td>493</td>
<td>English Sparrow.</td>
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**Trees.**

468 Study of Tree Planting in Schools.
134 Tree Planting on Rural School Grounds.

**Animals.**

196 The American Toad. (A bulletin that every teacher should have and read.)

**Insects.**

543 Common White Grubs.
657 The Chinch Bug.
679 House Flies.
659 The True Clothes Moths.
740 House Ants.
444 Remedies and Preventives against Mosquitoes.

**Weather.**

98 Weather Bureau; How Forecasts are Made, etc.


**Boys' and Girls' Clubs.**

562 The Organization of Boys' and Girls' Clubs.

**Agriculture.**

586 Collection and Preservation of Plant Material for Use in the Study of Agriculture.
606 Collection and Preservation of Insects and Other Material for Use in the Study of Agriculture.
607 The Farm Kitchen as a Workshop.
617 School Lessons on Corn.

5. **Miscellaneous Materials for Nature Study.**

A teacher, by watching advertisements and by a little thought in other directions, can obtain many materials which can be of help in connection with nature study.

We suggest the following:

1. Manufacturing concerns often put out pictures of birds, flowers and other nature-study subjects for advertising purposes. We recall a soda company, a sewing-machine company and packing house which have recently distributed such pictures. Children will delight in bringing pictures and clippings.

2. "Perry Pictures" of birds are obtainable from educational supply houses for one or two cents each.

3. Write to friends or relatives in other parts of the country for plants, fruits and other products typical of that part of the country. Write to southern friends for cotton bolls, to California friends for orange leaves and blossoms, to northern and eastern friends for samples of nuts in their original shells. These are a few suggestions. Such things help to make geography real.

4. Magnifying glasses, magnets, compasses and other inexpensive bits of apparatus can be obtained from educational and scientific supply houses. For example, any of the
three things mentioned above can be obtained from the Central Scientific Company, Chicago, Ill.


6. Send for flower, nursery and seed catalogues. They contain valuable pictures and information which can be used in making a nature scrapbook.

7. Medical almanacs, obtainable at drug stores, contain dates of eclipses, phases of the moon, evening and morning stars, etc.
VIII. In Conclusion.


2. Childhood has a consuming curiosity and interest in everything. It is nature's provision for educating. Use it.
3. The above leads to numerous questions. Never fail to help childhood answer its questions, if possible.
4. Children constantly want to know the names of things. Satisfy them if possible. It is their method of vocabulary building—their first language work, if you please.
5. Children are "born imitators"—merely another of nature's educational methods.
6. Play. The young of all animals learn life's serious tasks through play. Play is an attitude, not a thing. Use it.
7. Self-activity. Above everything let children learn for themselves, find out for themselves. They then joy in their job.
8. Books are often obstacles to self-activity. Books are to be used as guides and references, but they give second-hand information, not first-hand.
9. Hit while the iron is hot. When a problem arises in a child's mind, that is the time above all times when it should be met and conquered. That is the time when that particular problem and its answer should become a part of that child's equipment for life.

2. A Final Word.

We trust that teachers who have looked through this bulletin have discovered that we use the term "nature study" to designate a way of doing things.

Sometimes teachers have reported something like the following: "The people in my district object to such new-fangled notions, and I don't dare teach nature study."

Where a teacher feels that such is the case, one of three things is the matter:

First: Perfectly innocent and well-meaning people often shy at a new name. The moment they hear that their children are studying something with a new name, without investigating the content, they condemn it at once. If good, old-fashioned arithmetic or grammar were to stalk forth in new garb, some one would hold up his hands in holy horror or righteous wrath, or something of that sort, and send forth a mournful wail.

The second is like unto it. Sometimes teachers make a big to-do about a perfectly natural and simple way of doing things. They proclaim it from the housetops as though it were wonderful to behold. And cause number one follows.

And finally, brethren and sisters, we sometimes do a bungling job of trying to be natural. After all, "tact" and "common sense" are just other names for being natural. Sham, veneer, artificiality and "policy" are not kin to common sense.

And so if we were to preach a final sermonette—which we will not do—we would say: Be natural. Go about your nature study as though it were a common, everyday affair, which it should be; as though it were the simple and natural thing to do, which it is; and as though no one knew the difference, which they will.

If some one objects, go ahead quietly so as not to wake the dead; if the name frightens some one, don't use it, but go ahead—you don't need the name; if you doubt your own ability, don't let you know it, but just go ahead; and if we can help, let us know; we are anxious to try. But don't stop; go ahead.

And so if we were to preach our final sermon we would say: Be natural, and go ahead!