

BIOLOGICAL MATERIAL BEST SUITED TO
MAINTAIN AND DEVELOP
THE QUESTIONING ATTITUDE OF THE CHILD MIND.

by

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T H E S I S

BIOLOGICAL MATERIAL BEST SUITED TO MAINTAIN
AND DEVELOP THE QUESTIONING ATTITUDE OF THE
CHILD MIND.

ANIMAL LIFE.

INTRODUCTION

The natural state of the child's mind seems to be the enquiring one. "What's that?" is the chief expression of childhood. By the time the children arrive at school many of them have had the edge of this questioning attitude dulled by lack of proper answers to their enquiries, or by lack of knowledge of their mental needs. It is the verdict of a number of investigators, that many who arrive with this spirit unimproved or even sharpened and quickened by the training of understanding parents soon meet with so many discouragements to it, that it is dulled or entirely lost somewhere during the school life.

As stated by the title, the purpose of this series of biological problems and projects is to furnish material, suitable for the various ages, to maintain and develop this questioning attitude, by directing the child to stimuli that will keep him questioning, lead him to make true comparisons, see relations, and arrive at correct conclusions.

The child's curiosity must be aroused and stimulated, he must be encouraged to question and wonder. To do this, he must be sent out to look for something specific, as the

difference between the foot of a horse and the foot of a cat; the flying friends of the honeysuckle; the flying part of the moon-flower; the tree in blossom; the ears of the katy-did; the way the mussel walks with only one foot; how the snail eats; how the swift builds its nest; how it procures the material for its nest if it never alights upon its feet; where the dog's knee is, if the same bones make its knee as make the boy's knee; how dogs swim; how birds fly; where the bat carries its parachute and how it is made; where the bat carries its young; how moths and butter-flies feed; a moth that never feeds because it has no mouth; where the fire-flies stay during the day; where the street light bugs come from; why sparrows are so plentiful; where all the earthworms, seen after a rain, come from; how the birds can make such wonderful notes; how the frog breathes; how the frog croaks; where the tree sparrow builds its nest; why the woodpeckers stay with us during the winter; what bird is called the clown and why; what the butterfly or moth comes from; and a host of others. Too often the questions are too general. This gives the child no starting point for investigation. The approach to the subject is of great importance, for upon it depends much of the success or failure of the work.

In selecting material, great care must be exercised. The selection must always be made from material that challenges the interest of the child and not the material that appeals only to the adult. The material must be such as can easily be brought to the observation of the child, attractive

to him, capable of being studied in its natural habitat, easily procured and cared for by him, also, that, which produces an investigative attitude and a desire for real understanding.

Much of the investigation and search for material is accomplished outside of school from suggestions of the teacher or from projects selected by the child for individual work. The child's leisure time can best be spent in gathering first hand, out-of-door knowledge. Classes may take hikes to secure material or investigate some specific object that can not be brought to the school or home for study. The "Boy Scout," "Camp Fire" and "Walking Club" hikes afford fine opportunities for this work, as among the chief benefits to be derived are health, happiness, and understanding. The time was when the American lived with Nature and knew her personally, he must needs know her or go hungry, That he knew and understood her is shown by our early "Nature Poets" and writers. If our children are to understand these writers, they must be led to their source of inspiration and information.

One of the great problems of the modern home and school is, how to most profitably and happily ^{to} employ the child's leisure time. Life is surrounded with a wonderful variety of beautiful sounds, sights, forces, and life which are the sources for much of our art, music, and literature. The understanding of these and the enjoyment of life is greatly increased, oftentimes unconsciously, if one knows the names of the trees that help make the landscape beautiful, or the

passing bird with its flash of color or melody of song. Then let the child who would understand and love life study life.

Subjects suitable for the younger children should be such as lead to observation of the child's world. His powers of observation are keen, but need to be exercised if they are to be properly cultivated. It is known to all who have studied the child at this age, that his mind flits from object to object, as a humming bird from flower to flower, gathering from each something of joy and something for future use. The exercise of the senses is a delight to the child at this age. Life, activity, color and sound attract his attention. This attention can easily be guided to the life about him.

The study of the living door-yard birds makes excellent material as does also his pets: dogs, cats, pony, canary, parrot, or gold fish and the baby in the home.

The real problem and project teaching of biology should begin in the intermediate grades. This is the age when the driving forces of life begin to make the child restless and he is no longer satisfied with "It is so". He now wants to know how, why and if things are as the books and people say they are. He wants to find out for himself. He wants to make collections to study and compare. He is endowed, at this preadolescent age, with a curiosity none can satisfy. The problem is, how can this curiosity be kept alive? All the school has to do is to encourage this natural "why?" and lead the child to the place where he can find the answer for himself. This will develop in him, keener powers of observation and a quickened mental activity along all lines

of study, because of awakened interest and the power to see relations. The child ceases to ask "why?" when he sees no hope of learning "why?" and when his elders act as though "why?" is of no importance. Any material the child brings for study is worthy of investigation. The study of the adaptability of organs in the solution of the problems of life: food, protection, and reproduction, gives him a better understanding of the laws and forces governing his own body, which prepares him the better to understand his own adolescence. A thorough training in the study of the life of the region and watching the various changes in the life history of insects, birds, flowers, and mammals will prepare the child mind to understand the beautiful side of life development.

The state of Oregon has probably done more than any other state ~~also with~~ ~~line of~~ experimental work along this line so I quote at length from the report of the Executive Secretary of the Oregon Social Hygiene Society, Portland, Oregon. "Education In Sex and Heredity" A Practical Program for Preparing Men and Women to Adjust Themselves More Adequately to Their Social Environment by Henry M. Grant.

"It will be well before going further to clear up any question as to one phase of the program to be proposed. Nothing in this paper is intended to suggest direct sex instruction to children. The Oregon Social Hygiene Society would be the first to oppose such a plan."

"What the child needs to get from the school is a general and wholesome knowledge of living things and of social relation-

ships; not a detailed knowledge of personal human sex problems." "In the discussion of a grade school plan the needs of the child will be treated more fully."

GRADE SCHOOL WORK.

"The following plan for the teaching of elementary biology in the grades was developed as a result of years of discussion among leading schoolmen in Oregon. It has met with nearly unanimous approval from educators.

The plan is entirely practical and has already been in successful operation in three school systems for two years. The only serious objection that has been raised pertains to the cost, and that has little force when the benefits of the work are considered.

Two years ago three first-class districts, at the suggestion of the Social Hygiene Society, introduced the teaching of biological science into the grade schools. These districts are at Ashland, The Dalles, and Newberg, Oregon. Three teachers were carefully selected for the work in these districts.

These teachers, in the first year of their work (the school year 1920-1921) instructed the third and fourth grades in their respective districts in the life histories of plants and animals. The children not only raised plants in window boxes and animals in quaries both at school and at home, but they brought in the various forms of life of the region and compared them with those raised. The conditions under which plants and animals live, where they grow, how they grow, the

various methods by which life is reproduced, etc., were carefully noted and compared."

"In this work reproduction is neither given undue prominence nor made to appear abnormal by being left out."

"This work will be carried on to the eighth grade as the fourth grade of two years ago advances. In the upper grades the human physiology and hygiene will be made a part of the course. The conclusion to be reached from the work of the past two years makes it certain that these children will, from their study of the human body, get results that have not been even approached before."

"Teachers able to carry on such work must be well trained in both biology and pedagogy. They must also be well-balanced and possessed of an understanding of the problems that lie back of their teaching and toward the solution of which their teaching aims. Three factors are believed essential to the success of this work. These are:

1. That the work be carried on by thoroughly trained teachers and by no others.

2. That no work be introduced into the upper grades until the children in those grades have had the work of the lower grades.

3. That the subject be taught through observation and experiment by the children and not through the giving of information by the teacher."

"Two years of this work has brought the conviction that such instruction will eliminate from the minds of children the traditional unwholesome attitude toward natural functions of

the body such as excretion and reproduction."

"It has also brought the conviction that children of eight, nine and ten years can be given a grasp of scientific methods, an ability to observe accurately, to experiment carefully, and to draw conclusions."

"This statement is confirmed by this quotation from W. E. Wiley, superintendent of schools at The Dales, Oregon:

'The work in biology in our grades has passed the experimental stage and is proving a greater addition to our curricula than was at first anticipated. The training in observation and habits of scientific thought - the art of weighing evidence - bids fair to produce a new type of student that will be far superior to the one heretofore so largely trained in rote memory work.'

"They who have watched the work develop are convinced that in addition to the above results this study is giving to each student such a body of facts as will be of great assistance in solving the personal and social problems of adolescent and adult years. It might well be mentioned that such work is a splendid remover of superstition."

"One of the results that has made both parents and teachers enthusiastic supporters has been the influence of the work upon the leisure time of the students." "The children taking this subject have for the past two years been so busy watching nature they have found much less time than usual for less ennobling pursuits. And this interest in nature is not a thing that will be easily lost. Such an interest will help to relieve idle hours and remove some of the strains from modern man's routine

life. The following quotation from William A. White's "Principles of Mental Hygiene" (page 256) is particularly apropos here:

'All this idleness, all this lack of interest in spite of the fact that the tiniest speck of dust contains the mystery of the universe, that any one of the hundreds of buzzing, crawling bugs that one may see on a summer's day will prove on the most casual observation to be bewilderingly beautiful and on more careful study equally wonderful.' 'One is tempted to blame the educational scheme which sends out into this wonderful world so many who 'have eyes to see, and see not' and 'have ears to hear and hear not.'

"Through their scientific work at this early period these children are acquiring an accuracy of statement that is most admirable."

"The grade school biology will be extended in Oregon just as rapidly as teachers can be trained."

A thorough training during the formative years of a child's life, gives him a life interest in scientific truths and often leads him to select scientific subjects for further study; for those things are most interesting about which we know the most.

It is not the purpose of this work to give formal scientific study but to utilize the child's natural curiosity and to put it in touch with the great field of biological truths. The child does not need nor does he care for the scientific classification and but little of the scientific nomenclature except some of the anatomical names as needed.

For more valuable to the child than anatomy and classification is the understanding of the habits and interrelations of the friends and foes of man.

The director of this work should be a thoroughly trained teacher, she need not have such a broad knowledge of science (although this is a great help) but she must have the power and desire to investigate and discover. She needs plenty of reference material at hand and know where to send the child for further information; although books are useful only for verification of discoveries and erudition. She must know how to arouse curiosity and lead interest. Pupil and teacher must work together. The teacher should not talk too much but should allow the child the joy of discovery. When a child asks a question, the teacher should say, "Let us find out about that" and together they should find out.

The work outlined in this course, is the result of sixteen years experimental work done in the grades of the Fort Scott schools. The work was planned and carefully directed through the first eight grades and the results carefully noted.

These results were as follows:

Leads the child to activity and creative action.

Correlates with geography, language, reading, art, drawing, spelling and hygiene.

Teaches children where to go for information and how to secure it.

Gives health and happiness, a subject which lies close to the home and makes life more worth while.

Teaches kindness, usefulness, and service.

Is the highest form of active not passive instruction.

Teaches what to destroy and what to protect.

Teaches child to understand great art and literature, therefore to appreciate it.

Keeps child out of mischief.

Awakens dull child.

Gives incentive for inventing and making many objects used in the work.

Keeps end organs active, carrying messages to the brain.

Gives child motive for work. Ex.: When drawing or painting for chart or record of any kind, the drawing is not the end but the means to an end and must tell the truth. The picture must be correct or it fails to answer the purpose for which it was created.

In the study of the life history of a bird, he learns the laws of the breeding season, the changes that occur, and the purpose of each, as the development of certain glands, when needed for home making, the love and care of parents; the love song, the family calls, molting changes after breeding and many facts of life, needed by him to interpret life.

PLAN OF PROCEEDURE.

The material is arranged in the form of problems and projects to give great freedom of choice. The first series is adapted to the younger children, the second to the pre-adolescent and the third to the adolescent ages.

"The aim is to set pupils to work informally and personally with objects, affairs, and phenomena with which they are in daily contact." - Bailey.

TIME FOR THE WORK.

School Time.

Formal recitations are very prone to become purely informational rather than inspirational.

A period of a few minutes each day set aside for questioning, informal discussions, suggestions or helps caring for material, or hearing reports is sufficient to accomplish much during a term.

Leisure Time.

Most of the work should be accomplished by field study out of school hours. Laboratory work may be done at home or at school.

SELECTION OF PROBLEM OR PROJECT.

Individuals or groups should be allowed to choose a subject, complete it, and make report and submit material and receive credit for same.

A careful study of a type specimen by the class is of great value as a model of procedure.

SECURING MATERIAL.

It is no trouble to secure quantities of material for class study as a little encouragement will cause the pupils to bring more than can be used.

We have had the following brought to school during the past year: insects, moths, larvae, pupae, and adults, bag worms on all of their varieties of hosts, ants' nests and ants; crickets; katy-dids and eggs; dragon flies; bees; honey and bumble; water boatmen; beetles; cicadas; locusts; fire-flies; cockroaches and many others; also, spiders, tarantulas, and centipedes from the commission house; trap-door spider with nest, from the South; scorpions, earthworms; leeches, snails, cray-fish, mussels, lobster sent from East, lizards, snakes, tortoises, soft-shelled turtle, fishes, gold and many varieties of native, the little stickleback in his wedding cloths; birds: swift, parrot, canary, sparrows, and pigeon, a ruby-throated humming bird in glass jar so all could hold and see; mammals: kittens, Angora and Persian; dogs: pet kid, young fox, young coyote, ground-hog, mice, opossum, moles, flying-squirrel, red squirrel, rabbits, guinea-pigs and brown-bats.

All animals are sent home as soon as class is through observing them. Our equipment for keeping them consists of two large aquaria, one breeding cage, one vivarium, and wire cage.

Our aquaria are changed as often as new objects of interest are to be studied.

PLAN FOR STUDY.

Arouse interest, by sending child out to verify some curious fact, by calling attention to some interesting phase of life, or by challenging ^{the} child's knowledge, challenge child to prove or disprove some statement that he questions.

I Knowledge must be gained by direct observation;

1. From living material:

- 1'. Field study (Food
a. Habitat- -(Protection
(Home
b. Habits
c. Friend or foe of man
d. Its friends, its foes.

- 2'. Laboratory study at home or school.
a. For close observation
b. For group study

2. From prepared material

- 1'. Laboratory collections
- 2'. Museums
- 3'. Private collections

II General information from,

1. Books
2. Magazines
3. Clippings from newspapers (to be used with caution.)
4. Experiences
5. Pictures.

III Records.

1. Individuals: notes, diaries, drawings, water-color sketches, and collections.
2. Class: charts, collections, and "Story Book."

(Too much recording dulls the subject.)

PRESERVING MATERIALS.

Individuals should be encouraged to keep a record of the work in an attractive way.

A diary of discoveries and incidents with dates, illustrations, and general information may be made very attractive and useful as reference material. The illustrations may be simple drawings to tell the story of what the child found. The child must be taught to observe carefully and accurately and record truly. He must be taught not to guess but to write down the results exactly as they are.

Water-color sketches, crayon and kodak pictures add much.

Clippings from newspapers and magazines, also colored prints of the animals are sources of information.

Making individual collections of material appeals to many.

Class material may be preserved in the form of charts, collections, illustrated story-books, and passe-par-toued mounted specimens, as a collection of beautiful bird feathers, wings of insects, feet of insects; skin of mole; head, skin and wings of brown bat or collection of moths or butterflies of locality.

One of the most successful methods of preserving material is to prepare charts, these may be individual, group, or class projects. The preparation of the charts is valuable to the one or ones who prepare them and the charts becomes valuable reference material and add quite a little to the equipment of the school.

One school prepared eighty charts of the birds studied in their locality during a year.

CHARTS.

The charts used in our school are the dark, gray mounting charts, twenty-two by twenty-eight inches. To make them more convenient for storing and carrying, they are cut through the middle crosswise, and taped on the back with adhesive tape so they can be folded. Drapery hooks are placed on the back at each upper corner so the charts can be hung on a wire.

In making a bird chart the following plan is used:

The chart is gradually built up as the material is secured and studied. For example, a beautiful gold-finch nest is brought in in the fall. (this nest is usually built in the fork of some very small limbs, so should be secured with the fork, cut just above and below the nest.)

Study location and material of nest, secure pictures of gold finch, male, female and young ones if possible, also in summer and in winter dress. Place these on the chart in an attractive way. The branch containing the nest may be wired on, fine spool wire is best for the purpose. Eggs, the right size may be cut and water-colored. The characteristic curve of flight of the bird studied and drawn. The beak, feet, shape of wings and shape of tail studied and drawn for chart. Secure food chart from government bulletin and draw for chart.

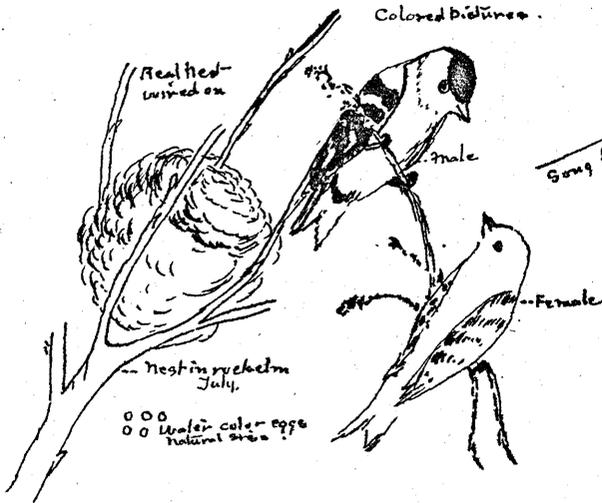
Quotations, pictures of food, and stories finish chart.

COLLECTIONS AND CHARTS.

1. Coverings of Animals.
2. Wings of Insects.
3. Homes of Insects.
4. Homes of Birds.
5. Homes of Mollusks.
6. Feet of Insects.
7. Feet of Birds.
8. Feathers of Birds.
9. Butterflies.
10. Moths.
11. Beneficial Insects.
12. Destructive Insects and Hosts.
13. Destructive Moths and Hosts.
14. Harmful Beetles.
15. Eggs of Insects.
16. Hosts of Bagworm
17. Heads of Sucking Bugs.
18. Heads of Chewing Insects.
19. Insect's Organs of Protection.
20. Insect's Organs of Defense.
21. Food Charts of Twenty Common Birds.
22. Collection of Foods for Winter Birds.
23. Shrubs and Trees that Attract Birds.
24. Bones of Birds.
25. Bones of Fishes.
26. Feet of Mammals.
27. Teeth of Mammals.

GOLD FINCH.

Colored Pictures.

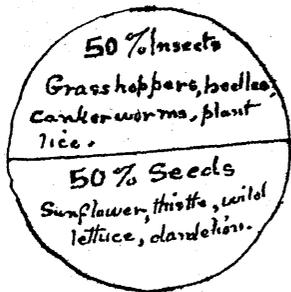


Chief Characteristics.

← Cone shaped beak (seed eater).

Strong feet for perching and feeding on weed seed.

Food



Water color pictures of all insects eaten by gold finch.

Water color pictures of all flowers or plants whose seeds are eaten by the gold finch.

Quotations from Literature

American Goldfinch

"Called also: Black-winged yellow-bird; Thistle Bird; Lettuce Bird; Wild Canary."

"In order to attract these cheery creatures about our houses, we must plant sunflowers in our gardens, only for the gold finches. They will come daily, during late fall and winter until every seed is gone."

Original Story.

The winter-dress of goldfinches should be known to all of us, as is shown by the following story. One winter day, some boys were shooting English sparrows. They noticed that when one fell its feathers appeared yellow beneath. They took it up and examined it and discovered that they had shot a beautiful goldfinch. They did not know that this beautiful bird stays with us all winter but changes his dress so that it looks almost like a sparrow.

They discovered that the winter dress was only a border of dull gray and brown on the edge.

OUR OUT-DOORS.

"Our Out-Doors" was the nature study department edited by the writer of this thesis in our daily paper for the purpose of interesting the children in the life about them and answering the questions they themselves could not answer.

The following questions in one issue brought forth the answers here given:

Why do birds have feathers?

How do birds fly?

Why should the English sparrow be exterminated?

What bird is called the clown bird and why?

Why do birds' beaks differ so greatly?

How does the bat carry her young? What does she do with them when she wishes to work?

Why has the tadpole a tail? When does it disappear?

Why?

What bird is called the "humming bird" moth and why?

Why should you keep a toad in your garden?

What is the most interesting thing you have discovered about the life about you this spring?

Virginia Hudson, age nine, Answers "Our Out-Doors" questions.

She says: "Birds have feathers to keep them warm. That is the reason the babies are hatched in the summer so they can get their feathers before winter."

"Some birds keep their wings flapping all the time.

"Some flop their wings just a little to get started then sail with the breeze."

"The English sparrows should be killed because they destroy the farmer's grain and because they are so noisy and querrelsome. If they were people they would be ousted."

"The yellow-breasted chat is called the clown because it sometimes acts like a clown, hanging by its feet and sometimes one toe. It rolls and tumbles in the air."

"The bills of birds differ so they can get the different kinds of food."

"The bat mother has her babies cling around her neck but when she wants to work she hangs them on a limb."

"The tadpole has^a tail so that it can swim like a fish. When it becomes a frog, the tail disappears and legs appear. It uses them for swimming."

"We had humming bird moths about our petunias and we just naturally called them 'humming birds' because they hummed so much and looked like humming birds. I guess that is the reason they were named humming bird moths."

"The most interesting thing I have found was a kill-deer's nest. It was no nest at all, but two very dark,

thickly speckled eggs, lying right on the stones in the pasture. The mother flew up, very much frightened, just as we rode along, so we looked for her nest and found it. They were just the color of the stones so we had to look sharp to see it."

FLOWERS AND BUTTERFLIES.

A nature-study paper from a twelve year old girl giving the results of her nature study project. This paper was completely illustrated with water-color sketches of the flowers and butterflies named. A fine example of the correlation of art, science, and language.

"Last spring our flower garden was spaded very deeply and the soil well pulverized. I planted my flower seed from one to two inches deep because sparrows are very fond of seeds so you must cover them well to keep the sparrows from eating them. Some of my plants came up the last of March and began blooming early in May. For butterflies and moths, I planted cosmos, snapdragons, salvia, larkspur, zennias, petunias and nicotine. From the time they began blooming until freezing weather, I had a continual procession of insects to study and add to my collection. To identify my moths and butterflies, I used the "Butterfly guide" and the "Moth Book" belonging to our school.

If you are interested in catching the moths and butterflies for a collection, you should make a butterfly net. For mine, I took a heavy wire large enough to keep its form and long enough to make a circle about eighteen inches across. The ends were twisted together for about six inches and attached to a handle about five feet long. For the net, I used a yard of cheese cloth. To make the net stronger, I put a tape binding around the wire where the cheese cloth was attached.

To keep my collection, I placed them carefully in

tobacco boxes because the odor of the tobacco drives away the insects that destroy the specimens.

There are many species of moths and butterflies in our locality which you can see if you keep your eyes open. Our school is working to secure a pair of every variety here. We already have a large collection. We press the flower on which they are found, and after killing the insect spread it on our spreading boards; then to keep them in an attractive way, we place them on cotton under glass and passe par tout them. We have a border around our room at school of the flower and insect side by side.

The butterflies and moths come as soon as the flowers begin to bloom, and a continuous variety are to be seen until frost. These are some that I caught and have in my collection: Papilio Philenor, commonly called the "Pipe-vine Swallow-tail," on the larkspur and zennias; the Junonia Caenia, called the "Pea-cock," on almost every kind of flower in my garden, although most often on the zennias; Meganstoma Caesonia, the southern "Dog-face" on the zennias and salvia; Anosia Plexippus, the "Monarch"; Papilio Cresphontes; Papilio Turnas; Argynnis Cybel, the "Great Spangled Fitillary;" and many other common kinds in great numbers.

Salvia, especially the common red-sage variety, attracted many hummingbirds.

In the evening, the moths, especially the "Hawk" or "Hummingbird" moths were very numerous and many varieties were watched as they poised gracefully above the flowers to sip the nectar. These are the mottled gray moths when seen at rest,

but when seen flying their beautiful underwings come into view.

These underwings show some of the most beautiful colors in nature as red, pink, orange, white and black.

I never dreamed insects could be so beautiful and interesting until we have been making a study of them.

I learned the names from our school "Butterfly Guide" by W. J. Holland and published by Doubleday, Page, & Co., Garden City, New York.

I am making water-color studies of all my collection. I like work in designing from them so much. Since I have watched them this summer among my flowers, and learned that they are necessary to the flowers and how each helps the other, Nature has become more wonderful to me.

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22. The Sphinx Moth.
23. Economic Value of Birds.
24. Protecting Our Trees.
25. Mother Love and Father Love in the Animal Kingdom.
26. Toads and Frogs.
27. The Frog.
28. Sight and Hearing of Birds.
29. The Mosquito.
30. Our Enemy, The San Jose Scale.
31. The Yellow Billed Cockoo.

32. The Humming Bird.

33. Whip-Poor-Will and Night Hawk.

34. Bird Characteristics.

35. Cockroaches.

SERIES I.

1. The Child.
2. The Sick Doll.
3. The Little Mother.
4. Project for Class.
5. Bathing the Baby.
6. Your Baby.
7. The Baby.
8. The Pet Canary.
9. The Robin.
10. The Goldfish.
11. Identification of Birds.
12. The Hen Mother.
13. The Pet Kitten.
14. The Pet Dog.
15. The Pet Frog.
16. The Pet Cricket.
17. The Pet Guinea Pig.
18. The Friends of Flowers.
19. The Bees and the Dandelions.
20. The Pet Pony.
21. Pet Day.

THE CHILD.

How many parts to your body?

Of what is your body made?

How do you move about?

How does the sparrow move about?

How is your body protected?

How is the sparrow's body protected?

How long were you a helpless little baby?

How long is the little sparrow helpless?

How long will it take you to grow up?

How long will it take the sparrow to grow up?

What do you eat?

What does the sparrow eat?

How many teeth have you?

What does the sparrow do for teeth?

How many joints in one of your arms and hands?

What does the sparrow do for a hand?

Name ten things you can do with your hands?

What can you do with your feet?

How do you protect yourself from bodily injury?

How does the sparrow protect itself?

What can you do that the bird cannot do?

THE SICK DOLL.

What does mamma Doll do?

What does Daddy Doll do?

What does the doctor Doll do?

What does the nurse Doll do?

Dress all for the part.

Prepare the sick room.

Diagnose the disease.

Give the treatment.

Keep all away from the sick baby. Explain why.

Take all sanitary precautions.

Make the game as realistic as possible.

Children love to play the game.

Let them name the disease. Teach the correct care.

Emphasize the family life and care.

THE LITTLE MOTHER.

FEEDING THE BABY MILK.

Materials:

Baby's milk-bottle	Nipple (approved kind)
Soda	Clean cloth
Borax	White soap
Cold water	
Hot water	

Big Doll

Cleaning the bottle and nipple.

Rinse in cold water then soak in soda, borax and soapy water. Scrub in warm soapy suds with clean brush, rinse in boiling water. Just before using, rinse again in boiling water.

Small, non-collapsible nipple. Scrub with warm soapy water inside and out. Wrap in clean cloth and boil. Never touch with the fingers the part of the nipple that goes into the mouth.

Always wash hands thoroughly before feeding. Before opening the milk bottle wipe off the top carefully with a clean, damp cloth to remove any particles of dust and dirt.

Dilute milk according to child's age and digestion. Pasteurize if it is not Pasteurized already; keep cool until time for use. Feed the baby by the clock. When it is time, shake the bottle gently to mix the contents, and place in a cup, pail or can of hot water to warm it. Test the temperature by letting a few drops fall in the inside of the wrist.

Hold the bottle while the baby is feeding.

When it has finished, place in upright position and

pat gently.

Do not play with baby while feeding.

Allow various members of the class to perform the tasks.

Many valuable lessons may be learned and enjoyed.

Drinking water for the Baby.

This too may be worked up for a lesson.

Bulletin: "Bottle Feeding. Kansas State Board of Health, Division of Child Hygiene, Topeka.

PROJECT FOR CLASS.

Make and equip nursery for baby.

Large box, windows on south and east.

Curtains, simple and of wash material.

Light and dark shades for windows.

Lower half of window may have a curtain supported by the casing, not the sash, so the air is strained before entering the room. Windows screened.

Floors which can be wiped with a camp cloth.

No rugs, unless small washable ones are used.

Woodwork: Simple, easily cleaned.

Walls: Painted, or covered with dull sanitas. Avoid bright reflections. (If dull sanitas is used, the children will delight in coloring a simple border)

Furniture: Crib, head and one side protected with cotton padding. Basket or bassinet, no frills, for tiny baby.

Chest of drawers for baby's clothing.

Something to hold articles for the bath.

Chair: Low and without arms, for mother.

Baby's bathtub.

Thermometer on wall.

Scales.

Arrange nursery for efficiency and convenience.

Equipment for crib: Mattress, rubber sheeting, sheets, quilted pad, soft blanket.

Children love to play, "The Little Mother" and many valuable lessons in hygiene may be driven home in these nature games, for some of the best "Nature Study material" is the child.

BATHING THE BABY.

Material same as mother uses, arranged just as mother arranges it. This may be borrowed for the occasion.

Bathtub (for baby)	Pure white soap
Bath thermometer	Box talcum powder
Bath towel	Boric acid solution
Face towel	Absorbent cotton
Wash cloths	Tooth-picks

Large Doll

Complete set of clean clothing arranged in the order of use.

Follow directions as given for a baby in the bulletin, "Bathing" issued by Kansas State Board of Health. Division of Child Hygiene, Topeka.

Fold bath towel on the table and lay baby, (doll) on it.

1. Before undressing it wash (or make believe) its face and head, taking care not to get soap into its eyes. Very little soap needed for baby's skin. Discuss beautiful texture of real baby's skin. How many love to touch the real baby's skin? How careful the mother must be to keep it in perfect condition. Rinse with clear water.

2. Pat skin dry, being careful to dry in all soft fat folds and back of the ears.

4. When thoroughly dry, pure talcum powder may be used.

5. Undress the baby, taking clothes off over its feet. Keep large bath towel folded under it to protect delicate skin.

6. Soap entire body, then holding it with the left forearm under the neck and shoulders, the left hand under left arm, and lifting the feet and legs with the right hand, put the baby (doll) into the tub. (If the doll is the unwashable kind only make believe) Children love "make believe." Continue to support the spine and head with the left arm and hand, while with the right hand, sponge the entire body, rinsing it thoroughly. (Test temperature before beginning)

7. Lift the baby out on to the bath towel and gently pat him dry. Never rub a baby's tender skin with anything less smooth than the palm of the hand.

8. Dress as rapidly as possible.

The little girls will love to be taught to do the work.

YOUR BABY.

Is he happy and contented?

Does he sleep well? How long does he sleep every day?

How long does he spend in the open air?

How often does mother feed him?

Does he cry after feedings?

What does mother feed the baby?

How careful must mother be of the baby's food?

Does the baby like to play?

How does he play?

Do you like to play with him?

Does he cry often? What do you think makes him cry?

Is your baby growing?

How old is he?

How much does he weigh?

Why does he love to kick?

Why does the baby crawl before he walks?

Does the baby crawl on his hands and knees, or on his hands and feet?

Has your baby ever been sick?

What must be done for a sick baby?

THE BABY.

How big was your baby when you first saw it?

Could it walk? Could it talk?

Did the baby have teeth at first?

How did mother care for the baby?

What did mother feed the baby? Do you like to watch
mother bathe the baby?

What was the first thing you saw the baby do?

How old was your baby when it could sit alone?

How old was your baby when it could stand alone?

How did it learn to walk?

Do you love to watch the baby?

Was your baby ever sick?

What did they do for it then?

What can your baby do now?

THE PET CANARY.

Home Study:

What is the color of your canary? Is there more than one color? What are they?

Is your canary larger or smaller than an English sparrow?

Is its beak long and slender or short and pointed?

What does it eat? How does its beak aid it to eat?

Does it use its beak like you do your hand some times?

Watch and see every thing it does with its beak?

Does its feet seem large or small for its body?

How many toes has the canary? How are they placed when it stands? How are they placed when it is on its roost?

School Study:

Cut out shape of bird. Cut out shape of beak.

See if you can find any eye-lids.

Feel how warm its little body is.

Examine its wing. Note the rows of feathers and how they differ.

Examine a feather very carefully.

Watch its throat when it sings. How do you think it makes its music?

THE ROBIN.

Does the robin hop or run? That is, does it hop on two feet at once or run, moving first one foot and then the other? How many toes has the robin? How are they placed when standing? When perching? How is he able to rest on a limb even sleeping there all night? What are the colors of the robin?

Can you tell the father robin from the mother robin? Have you watched them build their nest? What materials do they gather? How do they carry it? Can you find a deserted nest to bring to the class to study so you can tell just how it is built? Is it a large or small nest? Is the robin a large or small bird or just between? What bird that you know is smaller? What bird is larger? Does the nest seem just about the right size for mother Robin to sit in? How many and what color are the robin's eggs? How long must mother Robin set before the little ones are hatched? How do they look when first hatched? How do father and mother Robin care for them? How old are they before they leave the nest? Who teaches them to fly? Who teaches them to find food and eat? Watch a robin and find a good reason for believing he has eyes that can see better than yours. Does he seem to hear well? Can you tell from his call whether he is happy, frightened or angry? Can you tell the family calls?

THE GOLD-FISH.

Have you ever watched a child watching the gold fish in his mother's aquarium? What a rich opportunity for a nature lesson. If the school room does not already have an aquarium, secure one with one or more gold fish for this lesson.

How does the fish swim? Which fins are used for motion? How does the fish use its tail fin? The upper fin is called the dorsal fin. How does it aid the fish in swimming? Watch and see just how he uses it. The fins on either side just back of the gill openings are called the pectoral fins. How do these assist him in swimming.

How many fins has the gold fish and where are they located? Feel the fins and decide which parts are hard and which are soft.

Study the eye of the fish. Is it like your eye? How does it differ? Do you suppose the fish can see as well as you can? Does the fish take in the water at its mouth and let it out at its gill openings?

Can you draw a mouth like this fish's?

Can you draw his eye? Has it lids like your eye? Can the fish wink at you? Can you find his nostril? Does the fish breathe through its nostrils?

What do you feed the fish? Does the fish have teeth?

If the gold fish lived in the river, would it be seen by its enemies and soon destroyed? Can you see a line along the side of the fish, reaching from the gill opening to the tail? This line has little nerves that help tell the fish what is

near it. Can you find any ears on the fish?

What covers the fish and protects him?

How does the shape of the fish help him to move through the water? How does his covering help?

Do you know how he breathes in the water?

Is the gold fish beautiful?

IDENTIFICATION OF BIRDS FOR YOUNGER CHILDREN.

One bird studied and learned at a time.

Pictures, colored, of ten common birds.

Robin, English Sparrow, Blue Jay, Wren, Cat-bird,
Downy Wood-pecker, Flicker, Gold-finch, Blue Bird, Cardinal.

Study picture until child can readily recognize it and
ask child to look for the ^{living bird} and report when he is sure he has
seen one.

Keep each child's record until all can identify ten
birds.

Encourage them to observe closely enough to tell the
father bird from the mother if possible. Learn one way they
can be sure of identifying each bird.

Have they ever seen more than one kind of bird whose
color is red? Whose color is blue? Whose color is yellow?
Whose breast is red? Whose color is light redish brown?
Is there a bird that looks like the English sparrow but is
not one? What birds have red only on their head?

Find a bird with a long tail. One with a short tail.

Find a Bird with a long beak. One with a short beak.

One seen often on the ground. One seen on tree trunks.
One seen only in the air. One seen most often in the trees.
One seen only in the evening. One seen in town. One seen
only in the country.

THE HEN-MOTHER

Secure a setting-hen just ready to hatch. Bring to school to observe for observation lessons. She may be kept in basement and children taken to see the little ones just out of the eggs.

How does the mother keep them warm? How do they look when just hatched? How long before they can run around and pick up particles of sand? They must not be fed for about two days as they take in enough food, just before hatching, to do them for that time. You will find no teeth in the little chicken's mouth. As they do not get milk from their mother, they must early prepare to eat for themselves. The sand they are given at first is to take the place of teeth and grind up the food they are to be given later. How do they drink? They may have water very soon. Why do they have fluff in place of feathers like the mother. Does the mother love and care for her little ones? How does she feed them?

Can you tell by the mother's cry whether she is happy, frightened, hungry, or calling her little ones? How many different calls have you heard the mother make? How many different calls have you heard the baby chicks make?

THE PET KITTEN.

What do you feed your kitten? How does she drink her milk? When you give her a meat bone, how does she eat the meat? Does she begin eating as soon as you feed her or does she sniff around her food to see if it is allright? Does she try to runn off with her bone to hide it as a dog will? How does she hold her bone while she eats? Does she stand up or lie down while she is eating? Does she take her time to eat or does she eat in a great hurry? What kind of teeth does she have? Do her claws assist her in holding her food? If she licks your hand, does her tongue feel rough or smooth? Does she lick the bone? Does she seem to chew her food well as you are told to do? If another cat or a dog comes up while she is feeding how does she act?

How does your kitty drink?

How does she keep herself clean?

Does she seem to sleep a great deal during the day?

Does she seem to like heat or cold the better? Give reason for your answer. What animals have you seen in the circus that looks something like your kitty?

How does your cat protect herself?

How does she care for and feed her little kittens?

How do the little kittens play?

Did you ever see the mother bring them a mouse?

Can you tell how your kitten feels by the sounds she makes?

How does your kitten express her feelings?

You tell your mother, how does the kitty tell hers?

How did your kitten act the first time it saw a dog?

Why? Does it act the same now when it sees a dog?

How does your kitty climb a tree? How does it come down the tree?

THE PET DOG.

How large is your dog? How much does it weigh? Can you lift it?

What does it eat? How does it eat? How much does it eat each day? How does it drink?

What kind of teeth does your dog have?

Does it bite off the meat as you do or does it tear it off? Which teeth do the tearing?

Is your dog's foot like the cats? Are its claws sharp?

Does it sleep during the day like the cat?

Does it sleep soundly or is it easily awakened?

How does it defend itself?

How does it keep itself clean?

Does it like to play with you? How does it play?

Can you tell by the sounds it makes whether it is happy, angry, hungry, or frightened?

Is your dog ever sick?

What animals in the circus look something like your dog?

What does the dog's nose tell it?

How are dogs useful?

Do you like your dog?

THE PET FROG.

Every school should have a pet frog for a time for the children to watch.

In the fall, just before time for the frogs to go into hibernation, the frogs have stored food in their body to last for several months, so the food problem is not a serious one.

Secure one or two frogs and place in an aquarium, stones and dirt should be placed at one side for the frogs to stay on a great part of the time.

Place a frog in a glass jar of deep water and allow the class to watch him swim. How does he do it? How do his feet assist him? Can he breathe under water? How does he rest in deep water?

Open its mouth and examine its tongue. It is attached to the front of its mouth so that he can throw it out quickly and catch a fly on the wing. You know how quick he must be if you have ever tried to catch one. The frog's food is living food which he catches in action so he must be quick indeed.

Watch the frog breathe and see how differently he breathes from you.

Take the frog out and watch him jump. What distance can he jump? This distance is how many times the length of his body? Which legs are his jumping legs? Do they have large muscles?

Notice the hump on his back where his hind legs are attached. Does this help him to jump? How does he croak? Place thumb and fore finger just in front of hind legs and

hold the frog up in the air and it will croak. Have the children watch and tell what happens when it croaks.

How does the frog defend itself from its enemies?

Try to hold one and you will be sure to find one way.

THE PET CRICKET.

Material: Couple of live crickets, flower-pot, earth, small plant, lamp chimney, piece of cheese-cloth, and small piece of apple or juicy fruit.

Fill the flower-pot with the earth. Plant with small plant and keep moist. Set lamp chimney into the earth, over the plant and tie over top the piece of cheese-cloth. Put the crickets under the chimney. Cut the apple, and place fleshy side up, the crickets will soon come to eat. Encourage the children to watch the process and observe carefully how differently the cricket eats from them. Notice how the jaws move as the cricket eats. The crickets will soon make themselves at home and if you have secured the male he will sing and the children may watch to see how he does it.

Look for the ear, an oval disk on the first leg of the cricket.

Notice how he breathes and how his abdomen moves up and down during the process. Explain the breathing pores of insects and secure a grass-hopper to show them.

Note:- The male has larger wing covers with scrole designs. This scrole forms the support for the wing drum head. Near the base is to be found the file and on the inner edge of the same wing near the base is found the scraper. He lifts his wings at an angle of forty-five degrees and brings the scraper against the file to make his chirp.

The food for the crickets may be apple, melon, carrots or other sweet juicy fruits.

The female may also be distinguished by her long sword-like ovipositor on the posterior part of her body.

THE PET GUINEA PIG.

Nothing would please the children better than to have a guinea pig at school for a few days to watch and study.

A mother guinea pig with her young would be very delightful.

They will be much surprised to learn that it is not a pig at all but a cousin to the rabbit.

What color or colors? What is the size? Measure to find out. Weigh one for them if scales can be secured. They are gentle and may be handled by the children.

Allow the children the joy of feeding them.

Their food consists of lettuce, apples, carrots, milk and rolled oats. Keep it supplied with water although it does not often drink when supplied with plenty of vegetables and fruit.

Study its legs. Do you think it could escape its enemies by running? Could it leap like its cousin, the rabbit? Is it fitted to protect itself? Has it ears like the rabbit? Can it turn its ears to catch sound like the rabbit does?

Watch it eat. How does it eat?

Has it whiskers? Of what use are they?

Does it play like your kittens do?

Describe its voice. What animal has a voice something like the guinea-pig.

Can you tell when it is angry? When it is happy?

Does it clean itself like the kitty?

How does the mother care for her little ones?

Could you keep some of these pets in your yard?

Do you know where the guinea pig comes from?

THE FRIENDS OF FLOWERS.

What do you see visiting your flowers during the day?

What do you see visiting your flowers during the evening?.

What do the visitors seem to be getting from the flowers?

Do you ever see them alight on the flowers?

Do those that visit them during the day alight with their wings folded together and standing straight up?

Do those that visit them in the evening alight with their wings opened out?

How does the humming-bird visit the flowers?

How does the humming-bird moth visit the flowers?

How many pictures can you find of the friends of flowers?

Can you name five of these friends and the flowers they visit?

THE BEES AND THE DANDELIONS.

Have you seen the bees flying from dandelion to dandelion? What were they doing? What were the colors of the bees? Did you see their eyes? Were they large for the head? Did you see the queer mouth gathering something from the dandelions? Did you see the bags of the honey-bees filled with pollen for the little bees? Why can't you play with the bees?

The bees and dandelions are good friends, do you know how they help each other?

The teacher will tell you all about this beautiful friendship.

Can you catch a bee without letting it sting you? Place it in a glass bottle and examine it closely so you can describe its head, wings, stinger and pollen bags?

When do you see bees? Do you ever see them during the winter?

Are bees useful to man as well as useful to flowers?

THE PET PONY.

How large is your pony? How much does he weigh?

How fast can he go? Does it take very long for him to lift one of his feet from the ground? Look at his hoof. Is it anything like your foot? Your knees bend forward. How does your pony's front legs bend? How does its hind legs bend? When he lies down, how does he bend his legs? If you walked like your pony, you would walk on your middle toe. Could you do that?

What does your pony eat? How does he eat? How many teeth has he? How does he drink? Can you see how the water passes up his long neck?

Does turning his ears help him to hear? What makes you think so?

Are his eyes beautiful? Does he have eye-lids like you do? Are his eyes shaped like yours?

Name all his means of protection.

Tell a story about your pony.

PET DAY.

Ask the children what pets they have. Make a list of these on the black board. Decide which could be brought to school for observation. Encourage the children to make their pets as beautiful as possible for the visit. Even a pony may be brought to the school yard.

Comparisons as to size, covering, food, young, manner of locomotion, beauty, usefulness, playfulness and habits may be made.

Topics of conversation may be the friends of each, the enemies of each, tricks of each, why they love their pets, and how they care for them.

Children love to imitate the various calls of their pets.

Secure pictures of as many of their pets as possible and make a chart of them.

Make a list of all the discoveries made by close observation.

Secure all the stories about their pets and make a story book.

SERIES II.

1. The English Sparrow.
2. The Robin.
3. Bird Material.
4. A Pair of Canaries.
5. The Bird Bath.
6. The Feeding Station.
7. Homes of Birds.
8. What the Beaks and Feet Tell you about the Life of Birds.
9. The Woodpeckers.
10. Bird Migration.
11. The Hen.
12. Comparison of Chickens and Ducks.
13. Adaptability of Limb to Life Problems.
14. The Monarch Butterfly.
15. The Hummingbird Moth.
16. The Cicada.
17. Bees.
18. Tortoise.
19. The Flying Squirrel.
20. The Rabbits.
21. How is a Fish Adapted to Its Habitat?
22. Flowers and Their Flying Friends, the Insects.

23. The Fox-Squirrel.
24. The Screech Owl.
25. The Orioles.
26. Beneficial Birds.
27. Birds' Nests.
28. Dragon Flies.
29. A Trip to the Circus or the Zoo.
30. Meadow Mouse or White Footed Mouse.
31. The Electric Light Laboratory.
32. The Aquarium.
33. Life History of Moths.
34. Nature Study at the Picture Show.
35. The Child's Study of Himself.
36. Exercise.
37. Spiders.
38. Our Bird Friends.
39. Coloration of Animals.
40. How Animals Spend the Winter.
41. Man's Best Companion among the Beasts.
42. The Horse.
43. The Cow.

THE ENGLISH SPARROW.

Field Study. (One or two questions daily).

Does the English sparrow hop on two feet or run like you do first on one foot and then on the other? Name all the colors you can find on the sparrow. How do you tell the father bird from the mother bird? How many toes has the sparrow and how are they arranged when standing, when perching? Who can find and bring a nest of the English sparrow? What materials are used in the nest? Is it a winter nest or a summer nest? Have you ever seen the eggs in the nest? How many were there? What were their colors? How were they marked? Listen to an English sparrow about your home and see if you can tell all of its calls, love, anger, quarreling, mother-call, hunger call, goodnight call, and good morning call. What places do they seem to like best for their nests?

Have you ever seen the little ones when just hatched? How are they dressed? What food do they sparrows eat? Do they eat when flying in the air, when in the trees or when on the ground? Do they ever destroy useful seeds? Do they stay with us all year?

How many months in the year do they nest?

Are they friendly with other birds? Do they go in pairs or in flocks?

Laboratory Study:

Bring in English sparrow for class study.

Keep in cage.

Study shape of beak, shape and size of birds,
Color and markings, arrangement of feathers and
spread of wings.

Study how it is shaped for flying. Feel its little
body under its wings, is it warmer or cooler than you are?

How do the sparrows keep from freezing when winter comes?

Give all the reasons you can for believing sparrows are
not friends of man?

Make a sparrow chart.

THE ROBIN.

Do you know where a pair of robins built their nest last summer? Did you observe them closely enough to answer the following questions? If you did not, be sure and watch a pair this spring so that you can. Did you watch them build their home? What material did they use? How did they carry it? (If you did not see them, secure a last summer's nest and find out all you can about the material and structure from it.) How did they line their nest? Which bird worked on the inside, molding the plaster with the breast? Did you ever see a robin with a muddy breast? How can you tell the father robin from the mother robin? What time was the first nest built? How many eggs were laid? What were their colors? What is the size of a robin's egg? How long did the robins set before the eggs hatched? Did one bird set all the time or did they take turns? How did the young robins look when first hatched? Could they have taken care of themselves? (Are there any birds that you know of that are not hatched in this helpless condition?) How often did the parents feed them? How did the parents keep the nest clean? How long before the young ones were feathered out and learning to fly? Which parent seemed to be the teacher? Did the old robins use the same nest for their next family? Why not? How could you tell the young robins from the old ones when

they were old enough to leave the nest?

Does the robin stay with us all winter? What is the last date you saw him? What is the earliest date of his return? Can you distinguish a robin call from the call of other birds? Can you tell whether the call is one of joy, anger, hunger, fright, love, contentment, "good night" or "good morning"?

Has the robin many notes in his evening song?

How many can you distinguish?

What have you observed the robin doing that tells you that he has keen vision?

What evidence that he has keen hearing?

Note the shape of his beak, what food does he eat? About what proportion of animal food, seeds, and fruit?

Are robins enemies or friends of man?

How does the robin bathe? Does he prefer a shower or dip bath?

How does he perch on a limb?

Does he migrate in flocks or alone?

Make drawings of his beak, feet, tail and wings out spread.

Is he adapted to long or short flights?

Make a beautiful "Robin Chart."

BIRD MATERIAL.

The study of birds make an especial appeal to the child because of the bird's colors, movement, melody of song, and home life. The child is active and loves life and action in others.

Birds can be found at all times of the year for study and their work and life are always interesting. Give the child a real problem to solve about the birds, one that can be answered only by personal investigation.

Does the robin run, hop, or walk with both feet or alternating one and then the other?

How does the hen, the turkey, the English sparrow, the wren, the pigeon or the parrot move on the ground? How do they perch? The children often think they know, but on investigation find themselves wrong. Send them out to watch and see. How were the toes arranged? Were the feet large or small? Strong or weak for the size of the body? Were the legs long or short in proportion to the body? How does the length of leg compare with length of neck? How is the body balanced so that the bird can walk on two legs?

Can the children find a door-yard bird whose toes are not arranged like the robin's? How are they arranged? Where do they find these birds feeding? What birds do they find feeding on the tree trunks?

A PAIR OF CANARIES.

Home Study:

How do you distinguish the male from the female? Which is the singer? Does the other ever sing? Can you distinguish all the calls of the birds; those of hunger, fright, loneliness, joy, eagerness, scolding, love, or contentment? Are the birds kind to each other? What acts of friendship and love have you noticed between them? Do they ever try to help each other? What foods do they seem to like best? Why do they need grit or cuttle bone in their cages? What do they do with these? What does the shape of their beaks tell you about their food? What use is made of their beaks in eating their most common food? How are their feet adapted to perching? How are the birds protected? Take the temperature of the canary and compare with the temperature of a child.

School Study:

Study shape of canary, shape of beak, Watch it walk or hop around and tell how it is done. Watch it take a bath and describe the process. Why does it fluff its feathers? Why does it preen them? (Examine a feather carefully to answer this question.)

If mating time, watch the nest building process.

Count and measure the eggs. Cut correct size and color same. How long does the mother set before the little ones appear?

Are they beautiful when first hatched? How do the little canaries break their way out of the shell? Examine their beaks when first hatched and see if they have a tiny hammer like the little chicken does. A pair of canaries make fine material for they can be kept at school and observed during the whole incubation period.

Which ones of their wild cousins are to be found in your locality?

Canaries are friends of man. Can you tell some of the ways in which they are useful?

"Hay fever" patients should love the little gold finch, first cousin to the canary for they destroy so much weed seed of the weeds that cause hay fever.

Last fall I saw great flocks of gold finch feeding on the great rag weeds' seeds. They migrated from locality to locality as these seeds ripened.

THE BIRD BATH.

Have you a bird bath at home? Have you one at school? How many bird baths in your neighborhood? What birds come to bathe? Do they all bathe alike or do some take a shower bath while others take a plunge bath? What bird takes a shower? What bird takes a plunge? Make a record of all the birds you see come to bathe. If your school-yard has no bird bath, is there a good place for one? Could you secure one for your school-yard? Did you ever see birds taking a dust bath?

THE FEEDING STATION.

A feeding station is needed only during severe weather. Then it is a source of joy to the children, and benefits the community far beyond its cost. It encourages birds about our homes and schools and attracts many we would not otherwise see. Suet tied on trees when snow or sleet covers the ground and trays for crumbs and seeds when food is scarce is all that is needed. One severe winter, thirty-five different varieties of birds visited our feeding stations. The record was kept by placing the picture of each new bird on our winter chart. Many birds came up from the deep woods to feed. Not only was bird life protected, and our number of birds increased by the care given them by the children, but the children profited as well as the birds.

HOMES OF BIRDS.

Ask the children to secure nests of various kinds of birds after the birds have left them.

See who can be first to bring a new nest. Only one of a kind is needed.

With the nest as a beginning, build up story of home life of that particular bird. The materials used, how obtained, by which bird or both? How attached to nesting place? Secure nest on twig if possible.

The love and care of the little family. The work of the mother, the task of the father. The eggs. The condition of the little ones when hatched. The sanitation of the nest. The amount of food necessary to feed the young ones. All these facts from observations by the children.

Good house-keepers and poor house-keepers among birds.
Ex. Sparrow's nest, Gold finch's nest.

The changes in plumage during the mating season. Purpose of the male's brighter plumage. Make note of places where nests are found, on ground, distance from ground. In hollow trees, in chimneys, in burrows, on weeds, on trees or shrubs. Teaching of young to obtain food and flying. What birds are able to run about almost as soon as hatched? These birds are called precocial. Some are hatched blind and naked. Mention some of these. These are called altricial.

Eggs, number, color, size.

Development of little bird during incubation.

WHAT THE BEAKS AND FEET TELL US ABOUT THE
LIFE OF THE BIRD.

Field Study: Feet.

Did you ever see a swift walking, running or hopping on the ground? Procure a swift from some chimney and examine the feet and try to tell their chief use from their form.

Compare with the feet of a robin, a sparrow, a woodpecker, a hawk and a crow. Note the difference among these feet and account for them.

The numbers and type of bones in a bird's leg is the same as in your own although they are modified and a few are lost, to adapt the bird to its life. On what bones does the bird stand? Draw representations of the various types of feet studied.

Secure the leg of a chicken, find the tendon that causes the toes to grasp the perch. Study this and determine just how the bird can rest all night on its perch without becoming tired.

Find as many types of feet as you can and the purpose for which they are adapted. What can you tell about the life of the bird by the structure and modifications of the foot and leg?

What is meant by a bird being a digitigrade animal while man is a plantigrade?

Field Study: Beaks.

Since birds have no teeth and no hands the beak must

serve for these. What examples of the beak serving as a hand can you give? Examples of the beak serving as teeth. Watch birds securing food and study relation between kind of food and form of beak. How would a night-hawk secure the wood-pecker's food,--the larva in the tree trunk? Compare some of the beaks of the birds of your locality. Draw the characteristic ones and name the class of food they are best adapted to secure. Is there any relation between structure of neck or length of neck and form of bill? How can you identify a seed eater, an insect eater, an eater of insects on the wing?

Laboratory Study:

From bird collections and pictures draw the various forms of beaks.

Make chart showing all varieties of beaks you have found, label and tell for what each kind is best adapted.

Classify drawings on chart as "Seed Eaters," "Eaters of bark Life," "Eaters of Foliage Life," "Eaters of Rodents," and "Partakers of Nectar."

Make similar study of legs.

Bring chicken leg and study muscles that control toes. Study to find out the power that keeps a pigeon balanced on the perch. How does it keep its toes clasped around the perch. Make classified charts as for beaks.

THE WOODPECKERS.

STUDY OF WINTER BIRDS.

What members of the woodpecker family are found in your locality? Have you seen them on the trees feeding? How do they go up and down the tree trunk? How are their feet arranged for this life? How does the tail assist them? How does it hinder his going backward? Compare the woodpecker's feet with the feet of the birds that feed on the ground, as the pigeon, in size, arrangement of toes, strength, and length of leg.

What food is the woodpecker finding?

What shape is his beak? How long do you suppose the beak is? Have you seen him find a grub? Is a woodpecker a friend or a foe of man? How does the woodpecker drum? Why does he drum? When you hear one drumming, watch closely until you think you know how he does it? While watching you may discover the reason?

The downy woodpecker is busy on the trees about our lawns all winter and a never ending source of interest to children when their attention is directed to this little friend. During the severe weather they should be taught to tie pieces of suet on the trees for him. Some birds will grow lazy, if fed, but not little downy.

If one can be caught for laboratory study without harming it, many interesting things about its structure can be learned by closer study. The mouth may be opened and its peculiar tongue studied. The tail and claws that assist it

to hold to the tree trunks, and climb them.

Describe the downy. Do all downies have the red patch on their head?

Why does the downy remain with us all winter?

Do you know any stories about the downy?

Have you discovered any interesting incidents about downy while watching him?

BIRD MIGRATION.

Field Study.

What birds in your locality are permanent residents?

What ones migrate?

What birds migrate through your locality?

What birds are supposed to leave your locality that remain with you, only having changed their colors by molting, or because they are out in the woods?

Do any migrant birds from farther north winter in your locality?

What summer birds have you? Keep dates of their coming and going.

Make a trip to the woods in winter and see if you can find any birds that are supposed to have migrated.

Laboratory.

On outline map of U. S. locate your locality and show birds that migrate through there. Find out, if possible, where they nest in the summer and where they spend their winters and indicate on map.

General Information. References. Stories.

Before migration of birds was understood, what was believed concerning this disappearance?

Story of Golden Plover.

Arrives beyond Arctic Circle in June. In August arrives

in Labrador where it grows fat on crowberry. Soon leaves for Nova Scotia. Then sets out across the ocean for South America, twenty-four hundred miles away. They may or may not stop at the Bermudas or West Indias. Later they arrive in Southern Brazil or Argentine. The first of March they start on their northward journey through South America and Central America, arriving beyond the Artic Circle by the first of June, having covered a distance of twenty thousand miles. + (Hagner.)

Most birds migrate on clear nights at an altitude of sometimes more than a mile. Thousands are destroyed in storms and by dashing against lights. Different species have more or less regular paths and times of migration.

Reference

Frank M. Chapman

"The Travels of Birds"

D. Appleton and Co.

N.Y.

THE HEN.

If children live where they have chickens at home most of the work may be observational home lessons. If the children live in town and have no chickens for home study, secure a hen or preferably a hen and chickens for study some afternoon.

Examine the covering of the hen and find the various kinds of feathers. Note their differences. Which are chiefly for warmth and which chiefly for flying? Take the temperature of the hen and compare with temperature of a child. How are the feathers fastened to the skin? How does the hen keep dry? What is she really doing when she preens her feathers? Ruffle up a wing feather and see if you can straighten it out like the hen does?

Notice her feet, how are the toes arranged?

How can she stand on two feet when it requires four for the kitten?

How could the child eat if it had no hands?

What does the hen use for hands? How many things can she do with her beak that the child does with its hands?

Find her eye-lids. How does she wink?

Is her back-bone stiff or very movable? What part of her back-bone is very movable?

COMPARISON OF CHICKENS AND DUCKS.

Field Study.

How do ducks swim? How do they walk on land? When migrating how do they fly? How high do they fly? Do they usually fly at about the same height? How do they alight to feed? How do they feed?

How far does a chicken usually fly at one time? How does their eating differ from that of the duck?

Compare the way a hen rests at night with the way a duck rests.

Laboratory.

Secure a hen and duck for comparison. Compare placement of legs of each and note relation to balancing the body when running, flying, feeding, and sleeping. For their life habits would it be an advantage or disadvantage to exchange the leg arrangement of the duck and hen?

Compare beaks as to size, shape, and use.

Compare the wings as to size, shape and usefulness.

What means of protection has each?

Make chart showing drawings of parts compared. Give explanations of differences as to advantages and disadvantages.

ADAPTABILITY OF LIMBS TO LIFE PROBLEMS.

Relation of limbs to locomotion and grasping, walking, leaping, flying, swimming, running, climbing, for obtaining food, for holding food, defense, offense, for home building and for skill.

On what bones of your leg does your foot rest?

What bones make up your hand?

What would be the condition of the horse's leg if he walked on the same bones of his limbs as you do of yours?

Study the structure of your own foot, especially the arch and heel. Do you know of any animal that has an arched foot like you do? Why does a heavy person stand with feet far apart?

Compare the foot of a cat, horse and cow with yours.

How does it happen that a man can balance himself on two feet? Find the change in structure from four footed beasts that enables him to do this; foot, hip joint, pelvic girdle, spine, and attachment of head.

Could a man, if he wished, walk easily on his hands and feet? Try and see. How does a baby crawl?

How are the legs of the four footed beasts built?

Why large feet? Why small feet?

What changes are found in the structure of the extremities when they are designed for purposes other than locomotion and support?

What has the horse gained by changing from a four toed to a one toed foot?

What differences are found between extremities of leaping animals and running animals? What advantage has the mole's fore limb for burrowing?

Study your own hand? What advantages has it over the fore limb of a horse? Why is it divided into five fingers? Would it be an advantage or disadvantage to have the thumb like the fingers? If you had to lose three fingers and have only two remain, what two would you choose? Why?

Compare the thumbs of the members of your class, with each other as to length of joints, attachment and skill.

How much of man's development may be traced to the development and skill of his hand?

Why do men shake hands?

THE MONARCH BUTTERFLY.

Certain insects make excellent material for class study. One of the most satisfactory we have used is the monarch butterfly. This because the whole life history can be watched within a month, material can be obtained for each member of the class to watch for his own, because they are beautiful in all stages, because of the interesting flight of the adult and, too, because this is the only butterfly that migrates like the birds.

Each autumn, there are times when great numbers can be seen, but only once have I seen a real migration. The trees and vines along the river held myriads of them, clinging to each other in great masses, like swarms of bees, and giving to the autumn woods additional rich tones of color. We were fortunate enough to have our kodak and took the picture of the great hanging masses.

There is no general migration in the spring as only a few straggling, worn and faded females return with the appearance of the milk weed (their food supply) to lay their eggs and carry on the race.

Secure some of these eggs or caterpillars from the milk weed plants, place in glass jars, keep supplied with fresh leaves, (these may be kept for the purpose, by placing plants in water) cover the jar with cheese cloth, each child having his own and caring for it. The children enjoy watching the feeding of the larva and the changes and molting. Break a stem of the milk weed and show the children how the

larva loves to drink the milky sap. In from ten to twelve days the larvae are ready to make the change from crawling, active caterpillars to sleeping pupa. You can easily tell when the change is about to occur by the lazy actions of the caterpillars. Excitement runs high for each child is anxious to see his make the change. Whenever one begins to change, allow all to watch the phenomena, observing very closely, everything that happens. Keep the time required for the change. We have found it to vary from five to ten minutes. First the larva crawls to some place where it can attach itself; in our experiments it usually attached itself to the cheese-cloth, for ^{this} seemed to afford good attachment for the little button, called cremaster, which it forms at its posterior end, to hang its cradle by. Then it begins a series of contortions, the skin shrinking and a beautiful light case begins forming over the larva. The skin breaks and drops away as the case is formed. The cradle is very beautiful, being a light green with little golden dots on the ventral side.

Each day the pupils lift the cloth to note the changes, gradually the pupa darkens. In about twelve days the metamorphosis from sleeping pupa to flying butterfly takes place. The intense joy of the children in seeing the beautiful creature emerge, pump the life blood into the wings, and the wings unfold with their rich, deep colors is an experience not soon to be forgotten. Should child life be deprived of this joy? Will it not aid them in understanding the great plan of all life? Will it not teach them a greater respect

for life?

The form and structure of the butterfly can easily be studied; the antennae, for feeling; the spiracles, for breathing; the proboscis, for securing nectar; and the wings for flight.

Call attention to the beautiful color and design of the wings and the difference between the wing marking of the male and female. With a simple microscope the wing scabs may be seen to good advantage.

The flight of the monarch compared with the flight of most butterflies tells a story of independence. Have the children try to find out why his lazy, leisurely manner of flying.

The monarch makes an excellent specimen for drawing and coloring.

Its brilliant color is an example of defensive coloration because it advertises it so loudly that its enemies all know it to be the horrible/^{tasting}milk weed butterfly with its offensive odor and taste.

Older children may make drawings and crayon sketches of all stages of the monarch.

THE HUMMING-BIRD MOTH.

Have you a moon-flower or petunia bed in your neighborhood?

Just at twilight, have you ever seen a darting form about this flower?

Many people call this a humming-bird, but if you look sharply, you will discover that it is a dark gray moth. Now watch it closely as it hovers for a moment above a flower and you will see a long tube, longer than the body of the moth, dipping into each flower as it passes.

If you will catch one of these interesting and harmless creatures you will soon be able to learn why it is visiting these flowers. You will see, just in the middle of its lip a little coil like a watch spring; take a pin and uncoil this and you will see the queer but convenient mouth of the moth. It needs this sucking tube mouth, called a proboscis, to reach the deep nectary of the flower. Measure the uncoiled proboscis and see how deep a nectary it can reach.

Why does the flower place the nectary so deep within its corolla? So the moth will be sure and have some pollen grains dusted on him to carry to another flower.

How does the moth know the nectar is there? The moth flies in the evening or at night so the flowers develop a wonderful odor to tell him where to come. Night blooming flowers that enter into a mutual friendship with the moth, are usually white or yellow with a texture that sends back every ray of light so the moths can see them.

But where does this moth come from and where does it go?

What is the purpose of the moth?

After it has quaffed the nectar of the flowers by twilight and moonlight, it finds its mate, lays its eggs and dies.

The eggs are laid on our tomato plants or some other plant that the babies of this moth likes as food. Look on some tomato plants and see if you can find, underneath the leaves, some tiny eggs or green caterpillars. You would hardly think these the children of the big gray moth.

As soon as they are hatched, they begin eating and continue to eat and grow until they become large green caterpillars, called "tomato worms."

Bring in some of these, on a tomato plant, for observation.

Place the plant in a glass jar, half filled with loose dirt. Feed the caterpillar as long as it will eat. When it has completed its growth, it will dig its way into the dirt and form a dark brown case, called a pupa. Within this pupa case, the caterpillar changes to the dark gray sphinx moth.

Dig up the pupa, examine it carefully and see if you can see the form of the moth outlined in the case. Look for the so called "handle" on this pupa. This handle holds the proboscis of the moth.

Place a cheese-cloth cover over your jar and some day the moth will emerge from the pupa weak, wet, and trembling.

You should watch the moth unfold his wings; pump the fluid (his blood) from his body into them, see the color and design appear; when they have reached their greatest size and are dry the moth is ready to fly away to feast on the flowers and carry their pollen for them.

We have followed the moth through his complete life history; first the egg, the coming into life stage; second, the caterpillar, called the larva stage, when it lives to eat; third, the pupa, sleeping in its case; and fourth and last, the imago, the flying insect or the mating state, when its business is to mate and lay its eggs and die.

THE CICADA.

This material is easily obtained by every child, if they will but be directed to watch for it. In the late summer the children often notice the old "locust hulls" on the tree trunks. They seldom pause long enough to learn what life came from these but will learn to investigate further, if encouraged to watch for the insect that leaves this story behind. Ask them to watch carefully and see if they can find the cicada nymph as it crawls up the tree to complete its incomplete metamorphosis. If they find one (and they will soon find plenty) bring it to school and watch the change take place. (We usually place them on twigs in glass jars so the process can be watched.) The shell has usually split down the back by the time they get it to school and the insect is emerging.

They become greatly interested in the process as the cicada is then a beautiful, delicate green in appearance. Gradually the wonderful designs begin to appear on his body, his wings begin to unfold their gauzy structure, the life blood, which is green, is pumped into them, and they take form and color before the eyes of the children. Even three year old children have watched this phenomena of nature with great interest.

They can learn the structure of insects from this creature, learn to distinguish the difference between male and female by the musical apparatus on the abdomen of the male and the

ovipositor of the female.

How does the male make the shrill noise that is often so annoying on an early summer's evening? Why does he make it? Does he love the sound of his own voice? Watch one, on a tree, and see if you can find out how he makes the noise?

You have seen two stages in his life history, what do you suppose is the rest of it. If the female has an ovipositor you know she lays eggs, so there is another stage. Where does she lay these eggs?

You may, possibly, find a twig with a slit on one side where the female has deposited her eggs. In a few weeks these eggs hatch into little ant like creatures that fall to the ground and begin their under ground life. Underground, they outgrow their covering several times and shed it. They suck the juice from the roots of trees and in from two to seventeen years, depending on the species, they crawl out and up the trunks of trees as you find them.

Study structure of "old hull" of adult cicada. Examine mouth, what kind is it, a sucking mouth or a chewing mouth?

When the older children begin discovering and collecting, the younger ones soon follow. Many parents are also led to notice living things and work with the children.

One fall, while our pupils were studying the cicada, a child four or five years of age, that played under a large tree in the yard, began to notice the nymphs as they ascended the tree to molt. One evening, when his father returned, the child carried in a nymph that was just crawling out,

and told his father that in an hour that thing would take wings and fly. The father threw away the nymph, scolded the child for telling such wild stories, and threatened to punish it, if repeated. A few evenings afterwards, the child found one just to his liking, ^{with} the split, beginning down the back. When the father came home, the child took the nymph and the alarm clock and placed them beside the father and told him to watch and see that when the hand was at a certain place the thing would fly. The father's interest was aroused and together they watched one of the marvels of life.

I have a three year old cousin that never tires of watching these living objects of interest with me.

BEEES.

The dandelion we have always with us and where this is found, there, also, will be found the honey-bee and the bumble bee ready for our study to begin.

Few neighborhoods are without some bee keeper where much may be learned concerning the bee.

How does the bee gather the nectar and where does he store it for travel? How does he gather the pollen and where does he store it? How far does he travel from his home? Watch his flight and describe it. How can you tell a drone from a worker bee? If the drone never works, will you find pollen baskets on his legs? Have you ever seen a queen bee? How does she differ from the others? If near an apiary when bees swarm, watch them building their first comb. Do the bees fly to different species of flowers when gathering honey or do they stay with one kind until they are loaded? Do they gather honey and pollen from the same flowers?

Laboratory.

Find the tongue of the honey bee. Find the tongue of the bumble-bee. Take out and compare as to length. Which will take nectar from the deeper flowers? Measure several honey bees' tongues and compare. Why can't a bee get honey from red clover when a bumble can?

Examine the legs and find the bee's antennal comb. Why does the bee need to keep his antennae so clean?

Does the bee build his cell six sided or does the weight and pressure on the plastic wax cause it to take the six sided shape? Carefully examine some honey comb and form your own conclusions.

Taste the nectar from the flowers and compare with the taste of the honey. How do you account for the change in taste and thickness? How is the wax for the comb formed? Is any other substance found in bee hives except honey and wax?

The life history of the different bees of the hive is very interesting, as, is, also, their community organization. This information is difficult to obtain from observation, but much has been written on the subject.

Reading this information is interesting and instructive and may be used as follow up work after observation material is exhausted.

The value of bees as aids in the fertilization of flowers can hardly be over estimated.

This makes a very profitable subject for investigation.

TORTOISE.

Tortoises are quite common and easily obtained for study.

Watch a tortoise and note his walk. Why this gait?

Find all the evidence you can that the tortoise is related to the snake.

Is his body loose from the shell or does body and shell grow together? What is the substance of the shell? Of what use to the tortoise is the shell? Of what use to man is the tortoise shell? Can the tortoise withdraw completely within the shell? Look for the hinge in the plastron (lower part of shell) of the land tortoise. Of what use is this hinge? Can the tortoise close his shell completely?

Time the speed of the tortoise.

Has the tortoise teeth? Thrust a stick into its mouth and see what takes the place of teeth. Feed the tortoise some vegetables and watch it eat.

Note the length of the neck. The structure of the neck. Place the tortoise on its back and see how it uses its neck in righting itself.

How are its eyes protected?

If your tortoise has the plastron hollowed out, it is the male, if flat, it is the female.

THE FLYING SQUIRREL.

One of the most interesting creatures ever brought to our school for study was a baby flying squirrel. It was so young, when brought that we fed it with a bottle. The children vied with each other for the privilege of warming the milk and feeding it. They made it a warm nest of cotton and it grew and thrived.

A very beautiful and exquisite creature with its large interesting eyes, soft fur, and ruffled membranes which it uses somewhat like wings when gliding from tree to tree.

We exhibited it together with the charts the pupils had made in studying him, at our annual exhibit. He attracted more attention from the children than any thing there. We had many offers to buy him as so many wanted him for a pet.

The little animal is nocturnal in its habits and seems to dislike the day for roaming so he is seldom seen in our woods, yet is not uncommon in our locality.

Though the dainty creature is called the flying squirrel, it really does not fly but mounts to some high region as the top of a tree and leaps into the air and goes sailing downward and outward gathering momentum enough to permit him to curve when near the ground and carry him on an ascending curve to the limb of an adjoining tree.

Its head and body are about five inches long, its tail about four inches, this is flattened and aids in its flight.

It is a mammal, builds its nest in hollow trees ~~and the~~

and the family usually consists of from five to seven young.

They are the most playful little fellows when they come from their day's sleep at sunset, to frisk and rejoice in the moonlight. During the day they curl themselves up and look like balls of silky fur.

RABBITS.

Field Study:

A tracking trip is a fine beginning for the study of this animal. This should be taken just after a light snow fall, as the rabbit is nocturnal, due to its many enemies, early morning, before the tracks are destroyed, is the time to go out and see where and how the rabbit spent the night. Much can be learned about his feeding habits, his haunts, where he was in a hurry, and where out for a leisurely stroll.

If, on your trip, you start up a cotton-tail and a jack rabbit, time the speed of each and compare.

Study tracks of each and make drawings of same.

What evidence have you that the jack rabbit knows his power?

What is the rabbit's means of protection? What have you seen him do to protect himself? Have you ever found his home? Try to find one and study his burrow. Make a drawing of it and write a description of it.

Laboratory Study:

Rabbits are easily obtained for study. There is hardly a neighborhood without some breeder of rabbits or Belgian hares. Have one or a family brought for study.

If a wild one, why its color? Why its cottontail? Study structure of legs, are they made for speed or endurance? If jack rabbit can be secured, make comparisons of legs, ears, size and strength. Account for greater speed of jack rabbit. Study feet of rabbits, on what bones does the foot rest?

Compare fore and hind legs as to length, etc. Why this difference in form? Could a rabbit run? What is the purpose of the long ears? Why are they turned back when running? Examine teeth. What is the food of the rabbit? Study teeth for gnawing. What is the purpose of the whiskers? Why is the rabbit's nose always in motion? Why is it moist? How are the eyes placed? Is its field of vision large or limited? Does its hearing seem to be keen?

How does it perform its toilet?

Are rabbits born with the eyes open or closed?

Are they born naked or clothed in fur?

How long are they helpless?

How many usually in a family?

Are rabbits friends or foes of man?

Do they increase rapidly or slowly?

HOW IS A FISH ADAPTED TO ITS HABITAT?

Life Study.

What is the habitat of the fish? How must life in the water differ from life in the air?

Study all the outward form and structure of the fish that helps him live in water. What is the shape of the body to overcome water resistance more easily? How does the covering of the body help? Suppose the gill covers were turned in the opposite direction would it help or hinder his motion? What is the shape of the head to cut the water? What, that man uses, has he patterned after the fish? How does the fish use his tail? His dorsal and ventral fins? What seems to be the chief use of his lateral fins? Why are the eyes so placed? Why so protected? Do you suppose his vision is keen? What is the food of fish? Has a fish teeth? Do you suppose the fish rests or sleeps at night? Do fish fight?

How does a fish protect itself from its enemies? What evidence, from experience, can you give that a fish has intelligence?

Do you suppose a fish can hear? Can you find ears?

How many fish can you identify? How can you tell them from other species?

What fish are most useful to man?

FLOWERS AND THEIR FLYING FRIENDS, THE INSECTS..

Field Study:

What flying creatures have you seen about flowers?

Make a list of all you see for a week with the names of the flowers you see them visiting.

Have you seen a large gray moth darting about petunias or moon flowers?

Have you seen bees about the dandelions and clover?

Butter-flies about the zenias or way side thistle?

Humming-birds about the honey-suckle or trumpet flower?

Are they friends of the flowers?

What do you like about the flowers?

The color, the perfume and the wonderful variety of forms.

Did you ever think that all these colors, odors, stripes spots, and forms had to do with the likes and dislikes of the flower's flying friends?

Since flowers cannot move about as animals do, they have entered into a partnership with certain friends who travel for them. In exchange for nectar and sometimes pollen, the flying friends carry the pollen from flower to flower. This exchange of pollen makes the flowers stronger and more beautiful.

So we see that the insect or the humming-bird may be looked upon as the flying part of the flower.

Without the insect the flower could not flourish, without the flower the insect could not live. Let us find out some ways in which each are helpful to the other.

THE FOX SQUIRREL.

Common in our woods and in many of our towns is the fox squirrel. Many are also kept as pets so it is quite easy to study this interesting creature in its native habitat and in the school laboratory.

These playful little fellows attract the eyes of the children because of their cunning ways, swiftness of foot, noisy chatter, and pugnacity.

Ask the children to watch one of these closely for half an hour, making note of all his movements. How does he climb and descend a tree? Does he do this as your cat does? Why does he go as he does? How does he move on the ground? Is his tail a help or a hindrance to him in climbing? Describe his legs, feet, claws, and tell how he makes such wonderful leaps. How does he use his fore feet when eating? How does he wash his face? How does he use his tail? Can you examine his teeth? What do you think about them? How does he open a nut? Have you ever seen him storing his food? Have you ever found his store house? What foods have you found him eating? How does he carry his food? Does his food change with the season? How does he drink? Can you track a squirrel in the snow? What kind of a track does he make?

Did you ever see the little one when just born? How many little ones are there usually? How do they look? Can they care for themselves from the first or must the parents care for them for a while? How long must the parents care for them? Does the mother ever carry her young? Are their

eyes open when born? Do they have hair when born? How are their eyes placed? Do the squirrels have a large or a small field of vision? Are their eyes placed like the hunting or the hunted animals? How do you think their ears are placed for hearing? Does it seem to you they hear keenly or not?

How does the squirrel express his emotions? Can you tell when he is angry and when contented? Does he have a kind disposition? What trees does he seem to prefer for his home? Is his color protective or not?

Are they friends or foes of man? What beneficial things do you find them doing? What destructive acts do they commit? Do you know why the fox-squirrels are more plentiful than the gray squirrels?

Do you think it is a fine thing to have squirrels running free in our cities?

Can you secure a squirrel tail and skin and pictures and make up an interesting chart for class study?

THE SCREECH OWL.

Have you heard the weird wail of the screech owl? Have you heard the noisy little one, in some hollow tree as you were passing by? Watch for them when they are leaving the nest late in May. Of course you must look late in the evening. You may find them sleeping in the hollow tree or in some dense, shady tree during the day. We often find them in cedar trees. If you can capture one to keep for a day or two for study, you will notice many differences between it and the common day flying birds. These day flying birds have many enemies so must have means of detecting them, and escaping from them. The owl, flying at night, has few enemies. In place of being hunted, he, himself, hunts. Note the difference between the owl's eyes and the robin's, between his beak and the sparrows; between his feet, when perching and the robin's, between the location of the owl's eyes and the robins. This will tell you the difference between the hunting birds' eyes and the hunted birds' eyes. Its ears too, are adapted to its night hunting. Examine carefully the structure of the wing feathers and note the difference between them and those of the common birds. How does this aid the owl in his nightly hunts?

Are his colors adapted for protection? Why have so many superstitions arisen concerning this little bird? What is the food of the screech owl? How have men learned what he eats? Is he a friend or enemy of man's? What can you learn about its nesting habits? Does it remain in your locality all winter or does it migrate? If the pair can be captured you may keep

them for a while by feeding them insects, raw meat or living mice. If a nest is found, the young may be kept for a few days, but should be turned loose as they usually do not do well in captivity. It is very amusing and interesting to watch one awake from its day's sleep to begin its night hunt. One we had at school refused everything we offered it to eat, and seemed so broken hearted that we set it free after a few days. These birds are very fond of their mates and are said to mate for life so we freed ours for fear there was another broken heart as well as ours.

One summer, after the young were all grown, great droves of them invaded our city and for several evenings the trees were full of their silent, flitting shadows.. They make no noise at all when flying, due to their wing structure. Their screeching, weird yet fascinating sounds, seem to be their family calls. The little ones are very noisy, when about grown, and the chatter from the nest often tells you where they are to be found. If other owls are found, make a study of their characteristics and habits.

THE ORIOLES.

Early in May, listen for a clear, sweet whistle and look for a flash of orange and black in the leafy trees above your head. That is the builder of the wonderful nest that hung in the topmost branch of the elm on your lawn all winter. He is the Baltimore oriole so loved by Lowell, when he said:

"Hush! 'tis he!

My oriole, my glance of summer fire,

Is come at last."

A few days and his mate will appear, and then the new nest will be begun. Put out some string and bright colored yarn for them, for remember they can no longer secure enough hairs from the horses' tails. In almost every neighborhood, where there are tall trees, several pair of these beautiful birds will be found building and caring for their families. If you have never seen them building their nests you have surely missed a treat, so watch this year and you will be rewarded. By the time the nest is built the foliage will have become so dense that it is well hidden. Listen for the hunger cry of the little ones and watch the busy parents flying back and forth with food. These baby birds cry and squeal so much that they have been called the "cry babies of the world." It certainly is strange they cry so much when they have such a beautiful, swinging cradle and such attentive parents, but I suppose they are spoiled babies.

Secure some of these nests when the family have flown away for the year and note the material and structure. We have found that they seem to prefer the long hair from the horses' tails. Some nests brought in from the country were all horse hair, while those from the trees in town were chiefly twine and fibers.

Father and mother Oriole take great pleasure in preparing their swinging cradle. The father usually brings the material, while the mother does the weaving very skillfully with her long, slender bill and claws. The lower portion of the nest is woven very closely and much thicker than the upper portion. It is also much larger. Near the top, it is loosely woven to admit air to the mother and little ones. The top is smaller than the bottom for protection. They usually fasten the nest to a forked limb far out on the end or in the very tip top of the tree. This is to protect it from enemies such as the cat, snake, and in a few places the small boy. They anchor the nest securely in order that the eggs may not be broken or the babies tipped out. They line it with softest down, then it is ready for the eggs. When completed the nest is usually about seven inches in length. This style of hanging nest is called pensile by man. Longfellow well named these nests when he called them

"The half-way houses on the road to Heaven."

The orioles seem to prefer the cotton-woods for their nests but most any tall tree will do as the elms, black oak, sycamore, hackberry and ash.

These birds are native to the tropics where there are hundreds of varieties but only two varieties come to us, the Baltimore and the Orchard.

They were known to our grandmothers as the "fire-bird", the "hang-bird" and the "golden robin."

Their food consists chiefly of insects, about eighty percent. They are very valuable to have about our lawns and orchards for they destroy many destructive insects as the click beetles, slant lice, leaf beetles, striped cucumber beetles, pea weevils, curculios and caterpillars.

From their study, we know what Lowell meant in the "Vision of Sir Launfal", when he said, the poor were welcome to the hall as the "hang bird to the elm tree bough."

BENEFICIAL BIRDS.

Among our beneficial birds, numerous along our highways and byways is the meadow lark. During the first warm days of early spring, his call is heard, announcing that he is ready for the first insects that appear. Many remain here during the winter, feeding with the quail, and taken by many people for quail. He is often called the "marsh quail".

He is easily distinguished from all other birds by his bright yellow breast, marked with a large black crescent in the center, and a yellow line above the eyes and across the top of his head. The beak is long, strong and black, the legs and feet large and strong, showing that it spends most of its time feeding on the ground. There it obtains its food and builds its home.

When starting to fly it rises by a series of short flappings and then soars away with an up and down wave like motion. The distinguishing characteristics when flying is this wave-like flight, near the ground, its short tail, bordered on either side with several white feathers and its size about that of a quail.

The nests are easily found. Cross a pasture where meadow larks are numerous and when one rises suddenly from the grass, look for a nest. The meadow lark is one of the master builders and constructs a nest which, from above, somewhat resembles an Esquimo house.

The nest is made of grasses, placed in a deep depression of the ground, and over this is woven a beautiful dome-like structure. Some times they build a vestibule leading to the nest. This is to protect it from the keen eyes of their enemies, the hawk and crow. They lay from four to six white eggs, marked with black and purple spots.

The food of the meadow lark consists chiefly of insects. It is estimated that each one on a farm is worth twenty-five dollars. They eat alfalfa weevils, cut worms, army worms, caterpillars, beetles and grasshoppers. If you make a survey of all the meadow lark nests on one section of land you will have some idea of the value of meadow larks in the state of Kansas.

In watching these carefully for a season, we found that the most of the nests were destroyed by hard spring rains that drowned the little ones, and destroyed the nests. That many are saved is proved by the great numbers seen each fall.

The beautiful "Meadow-lark" has just been voted the state bird of Kansas by the school children of the state, receiving ~~over~~ 48,394 votes.

BIRDS' NESTS.

Make a survey of birds' nests in your neighborhood. Measure the distance from the ground of all the nests of each species and find the average height for each. How many birds were building on the ground? What birds' nests were built on the ground? Describe the nests. How were the little birds developed when hatched? Keep a record of all birds and the average height for their nests. Try to find a reason for this. Do birds seem to prefer high or low locations for nests? Do you find any relation between water supply and number of nests? Do birds seem to build more often near wild fruit supplies? What do you learn from these investigations? What wild fruits do you find the birds eating? Could these fruits be used advantageously for planting about our homes?

What lessons concerning the cultivation of birds can you learn from this investigation? What enemies of nesting birds do you find? Give some means of overcoming some of the destructive agencies of bird life.

These are some of the troubles I have observed in the bird world, how would you help these conditions. One little pair of vireos have built three nests and have left them all just as they were completed because a cow-bird laid her egg in their nest and they seemed to know the uselessness of attempting to raise a family there. They must have a great deal of patience and perseverance for they go cheerfully to

work building another nest. The majority of our birds build low in the shrubs, weeds, and grass and the heavy spring rain, raise the waters and hundreds of nest are destroyed.

DRAGONFLIES..

The beautiful iridescent colors and the graceful, darting movements of the dragonflies have long attracted attention, and many have been the stories told of them. Why these delightful friends of mankind should have been so misunderstood as they have must remain one of the mysteries. Many absurd superstitions have long been prevalent concerning these insects, among them the belief that they sewed up boys' ears and that they fed and doctored snakes.

It is an aquatic insect when in the nymph stage of its life history. The mother dragonfly creeps down the stem of the water plants and lays her eggs on the debris at the bottom of the pond. She is surrounded by an atmosphere of her own, while under water, for she has ceased to be an aquatic animal. Her eggs soon hatch into nymphs. Creatures that do not resemble the parents in any way, dirty, inconspicuous, wingless creatures, living in the ooze and slime at the bottom of the pond. These are very beneficial for they live on the larva of the mosquitoes. Their most interesting feature is their hinged mask attached to their lower jaw. It looks very much like the face of a bulldog. This can be shot out and assists them in securing their food. When ready for metamorphosis, they crawl up the plant stems to the rocks or logs and set in the sun. The old shell splits and out comes the beautiful dragonfly in all its splendor.

One evening in September, the west part of our city along the river was the scene of migrating dragonflies. The air was filled with whirling, darting masses of that species known as green skimmers. Several of the children secured their butterfly-nets and attempted to catch a number for nature study. They had great sport and learned that he who would catch dragonflies must needs be quick of eye and hand, and fleet of foot. The dragonfly uses his long abdomen as a rudder and can turn in the twinkling of an eye. It was a beautiful sight to see the maddening swirl of insects and children. The insects caught and brought to school were carefully examined. Their colors were the most exquisite iridescent bluish-green. They were about three inches in length. Their eyes, which stood out on the sides of the head, told us they must be able to see well in all directions to obtain their food and escape their enemies. Their neck aids them in this for it is so constructed that they can almost completely rotate the head. The strong jaws indicate the crushing and masticating of their prey. Their food consists of mosquitoes and insects caught on the wing.

Many female dragonflies deposit their eggs while hovering about an inch above the surface of the water, striking the surface of the water repeatedly with the tip of the abdomen, an egg being laid each time the body taps the water. Some others deposit their eggs in the stems of aquatic plants below the surface of the water.

A TRIP TO THE CIRCUS OR THE ZOO.

Make list of all animals seen. Look for outstanding characteristics and make note of the same. Group all the animals that resemble cattle and note the feet. Are they hooved and the hoof split like the cow? Do they seem to chew a cud like the cow? Do they all give milk? Note the teeth of all.

Name all that seem to resemble the dog. Group all that seem to resemble our common cat.

How many animals do you find with the parents and how do the parents care for them?

Study the elephant's trunk. Scientists tell us there are forty thousand muscles in this trunk. Make note of every thing the elephant uses it for. Note the elephant's foot, of what bones is it composed? Examine the elephant's teeth. Make a diagram if possible. How does the elephant drink? What is peculiar about his hip joints? What sense seems the best developed?

Study the foot and hind limb of the bears and account for the awkward gait.

Distinguish between the camel and the dromedary. Study the ostrich (especially feet and legs) and decide on his adaptability to desert life.

The kangaroo is a wonderful animal to study. Note front limbs and use of same, hind limbs and use of same, pocket for young and body structure.

What legs are used when running or dancing?

Examine closely the hands of the monkeys. Note their walking.

MEADOW MOUSE AND WHITE-FOOTED
MOUSE.

Where is the common habitat of each? Which is the more abundant? What is the disposition of each? Which is the easier tamed? When are they the most active? What is the food of each? Where do you find the nests of these little mammals? Does either one store food? Are they inclined to be sanitary in any way? How many broods a year? How many young in each brood? Are they native to America? Are the young born helpless? What are their enemies? To what are they enemies? How do they protect themselves? Are they useful to man? Are they useful in nature's scheme?

Reference.

Comstock, - "Hand book of Nature" - pages 226-228.

THE ELECTRIC LIGHT LABORATORY.

Are electric "light bugs" all bugs? Catch all of the different "bugs" you can that are found flying about the electric light at night.

Make drawings of each one found.

Where do they come from? Where do they go? What are they? What is the life history of each? Search for these answers for each kind found in nature-study books, zoologies, insect books, nature magazines and encyclopedia.

Make chart of "electric light bugs", drawings of various stages of life history, as found in reference books and from nature.

THE AQUARIUM.

How can the water in an aquarium be kept fresh without changing it often? Why do plants aid in keeping the water in a condition for water creatures?

If you are keeping a few water creatures in an aquarium that does not have a plant balance, how often should you change the water? How should the changing be made? Why have the fresh water at practically the same temperature? How do you care for the water creatures during the change? Why have a large water surface to your aquarium? How do you feed the water creatures so as not to pollute the water?

Why should the aquarium not be placed in strong sunlight? What is the purpose of shells and stones in the aquarium?

How can you tell when the fish are not getting sufficient air?

Why must the life in each aquarium be very limited?

What life do you find best adapted for the school aquarium?

LIFE HISTORY OF MOTHS.

One of the most interesting groups of moths to study is the Silk-worm family or the Saturniidae.

Early in the spring members of this family are often caught about the electric lights of our cities and in various other places. If the pupils are told to be on the look out for them, several will be found and brought for study. If the female is brought and she has mated, her eggs laid in the breeding cage or in whatever she is kept, will hatch into tiny larve. These must be fed on willow leaves, maple, cherry or elm. The larva feed and grow. In the fall, the larva^s ready to form their pupa may be found on these and other trees and broughtⁱⁿ, plac-
ed in the breeding cage and fed until ready to spin their silken case^{or cocoon}. This is very interesting for the pupils to watch. It is well to have a tomato larva at the same time for a demonstration of the different preparations for the pupa stage.

Keep a record of all forms brought^{in and} studied and during a school term the pupils will have had the pleasure and profit of seeing one of the most spectacular life histories.

The egg, and purpose of same; the larva, and purpose of this stage; the pupa, and its home; and the flying insect, or mating stage.

Have the pupils answer, by investigation, the question, "Does this adult insect ever eat after emerging from pupal stage?" What is the purpose of this imago stage?

The pupa are often found during the winter and brought to school. The pupils watch, with great interest, these beautiful creatures emerge, and develop their wings for flight.

The three members frequently found and brought are the Luna, the Cecropia, and the Polyphemus. The Royal seems rare in our locality but one or two are usually brought each year.

These insects are so beautiful in all stages that they make excellent material for charts, showing the life history of each, in passe-par-taute cases; and ink and water-color representations of the various stages; and detail drawings of most interesting characteristics.

NATURE STUDY AT THE PICTURE SHOW.

Make a list of all the animals you see at the movies and record all the actions that are interesting to you. Note the animals that take the highest training. Can you find out how the trainers produce such great results? What tricks seem very unusual for animals to do?

Make note of all the wonderful things dogs are trained to do. What acts indicate almost human intelligence? What breeds of dogs seem to take the highest training?

How far have they been able to train the chimpanzees, the monkeys, and the orangutans? What tricks seem easiest learned? What emotions, similar to those of human ^{beings} have you noticed these animals displaying?

Write a description of all animals seen, pointing out the chief characteristics that adapt them to their native habitat and life.

Do the animals perform any original tricks?

Do many of the tricks seem to be painful to the animals? Do they seem to enjoy doing certain tricks?

THE CHILD'S STUDY OF HIMSELF.

There is nothing more interesting and wonderful to a child than its own body.

What bone makes the heel? How does your foot differ from that of all other animals? On what bones does your foot rest? On exactly what bones do you throw your weight when you step - find out by experimenting. Is there any other animal with an arched foot? Of what advantage is it to man? Is there any other animal that throws the weight on the same portion of the foot as man, when walking or stepping off?

Study the form and structure of your hip that enables you to stand erect. How is it possible for you to hold your head up? Do you know of any other animal that has the eyes placed in the same position in relation to the head as you do? Compare your field of vision with that of your dog, your pony, your cow.

Study the joints of your thumb carefully. What advantage is having your thumb attached as it is rather than like your other fingers? Study the hand structure in relation to the skill of man.

Study the curves in your back bone and try to decide why so curved.

Name all the advantages, in structure, that man has over all other animals.

EXERCISE.

Is your body temperature greater after running around the block? Take your temperature, before and after and prove for yourself. Do you feel warmer? Explain why? Is your heart beating more rapidly? Are you breathing more rapidly? Count your pulse before and after to be sure. How do you account for the change? On how many places of your body can you count your pulse? Why?

When you come in from out of doors on a cold day, take your temperature. What do you find it to be? How does the body sustain this constant temperature? Why do we eat more heavy foods in winter than in summer?

Describe exactly how you take your temperature. Why sterilize the clinical thermometer before taking the temperature? What is normal temperature for man?

What is normal pulse, when at rest?

How much does yours increase when exercising?

Where can you feel the heart pulse best?

Under what conditions is the temperature above normal?

Below normal?

What has bodily temperature to do with health?

SPIDERS.

Secure a spider's web. Study the structure.

Make a drawing just as nearly like the web as you can. Watch the spider until you see her capture her food and describe exactly how she does it. If you see a spider making a web, watch the process and see if you can tell just how it is done. Catch the spider, with two sticks, and look for the spinnerets on the underside of her abdomen. Draw these as well as you possibly can.

When you find a silken bag of spider eggs, open the bag and examine carefully. What provision do you find the mother has made for the protection and food of her offspring?

Have you ever seen the male spider? What can you find out about the family life?

What becomes of the spiders when winter comes?

How is the race carried over to the next season?

Do you ever see spiders during the winter? Note the first ones you see in the spring.

Make a collection of all the spider "egg cases" you find during the fall, winter and spring.

Make a collection of spider webs and of the spider that made each.

In the fall, watch for ballooning spiders and make laboratory study of how a spider would solve the problem

of escaping from a high projection, surrounded by
water.

Reference.

- Comstock's - "Hand book of Nature Study" - Page 475.-481
" " - "The Spider Book."

OUR BIRD FRIENDS.

Take a bird census of your neighborhood and see how many birds you have with you at the various seasons. Many are these unseen bird-friends watching over the welfare of the plant world.

If a bird census were taken in our cities and towns, I feel quite sure our own Fort Scott would be in the first rank in number and variety of bird life. We are fortunately situated on the boundary line between the North and the South so have many of the birds of both regions.

One of the delightful birds of the Southland that we have with us from early spring to late autumn is the mocking bird, that bird with the wonderful voice that charms you with his song by day, and serenades you with his entrancing melody by night. He is our grandest singer and rivals the nightengale of Europe. There are those, that will tell you that, while his song fills you with intense admiration for his vocal powers, it does not thrill your soul with feeling, but go forth some moonlight night, when all the world is hushed, the air heavy with the odor of the orchards, and the dewy leaves glistening in the silvery moonlight, and hear him flood the earth with his ringing melody and if his song does not fill you and thrill you, confess yourself dulled to Nature's call.

After twelve, one moonlight night, in the early spring, we were fortunate enough to hear a superb mocker singing his most rapturous lay. He had sought the highest tip of the

highest tree in the neighborhood for his concert stage and with the moonlight for his footlights proceeded to give the grandest bird concert I have ever heard. It seemed that all the "spring feel" of the air had gone to his heart and his head and as he could not sleep for his overflowing feelings, he rose to give the glory to the sleeping world. No wonder that the poet, Lanier, wrote his beautiful poem of this bird when his southern home was surrounded by them.

There are so many interesting things to learn about the home life of this bird. His emotions are so all embracing that song alone is not sufficient but he must bound into the air and fall again and again to show his happiness.

Not only is he one of our sweetest singers, but one of our greatest destroyers of harmful insects.

Can you identify this bird by flight? Make a chart of all mocking bird nests in your neighborhood.

Keep the date of the first bird you see. Keep the date of the last bird you see.

Write up the stories of some mocking birds you have known.

What other bird friends interest you?

What are friends? Why are the birds friends?

Our friends are those about us that make us happy, that entertain us with their accomplishments that serve us with delightful luncheons, and protect us from our enemies.

Our bird friends do, in their shy way, all of these kindnesses so are worthy to be called friends. Who has not been entertained with the delightful song of birds?

All literature abounds with testimonies of their ability to entertain the great. Are you not happier all the day, having seen or heard the cardinal or blue bird or that flash of "living fire", the Baltimore oriole, or that living jewel, the humming bird? Do they not protect our fruit and vegetables from harmful insects and thereby make possible many delicious luncheons? Does not the little goldfinch/^{canary} tell our soldiers and miners of the deadly gas and so protect their lives?

How many of these friends can you identify when at rest, on the wing, or by their song?

How do they obtain their food and how do they eat?

How do they build their homes?

Many of their homes will be seen after the leaves have fallen and these will make a fine beginning for nature study.

An excellent nest to begin with is the Baltimore oriole's.

How is it built? Where found? Materials used if built in town; if built in the country?

With the nest as a beginning, build up a beautiful oriole chart, showing home, pictures of birds' eggs, outstanding characteristics, food chart.

COLORATION OF ANIMALS.

Give examples of protective coloration of insects, fishes, toads, frogs, birds and mammals.

Give examples of warning coloration.

Give examples of call colors among animals.

Give examples of changes with environment.

Why are fishes and water animals dark above and light below?

What is the difference between the color of the lion living on the desert and the one living in the edge of the jungle? Can you tell these apart when seen in the circus?

What is the best example of protective coloration that you know?

Why is the female usually less highly colored than the male?

Give all the advantages you can for the various colors of animals.

Give some examples of animals where the color aids in protection from their enemies, in securing their food, and in warning their enemies.

HOW ANIMALS SPEND THE WINTER.

Make a list of all the animals, in your locality that are to be seen both summer and winter. Which ones are not seen during the winter? Where are they?

How does the squirrel pass the winter? Is he out all the time or does he sleep much of his time away?

Is the rabbit diurnal or nocturnal? Does he hibernate at all during the winter or is he busy and active all the time?

The gopher is a warm blooded animal, is he seen during the winter? Where does the woodchuck stay during the cold season? Where are the skunks? The muskrats?

Give some of the ways animals live over the cold season.

What animals remain in the same locality but retire to sheltered regions and sleep until spring? What animals move to warmer climates?

What provisions do the animals that remain make for the cold season?

Most insects and lower forms of animal life die at the end of summer and the race is carried over in the eggs or pupae. What forms of life can you find carried over in the egg stage? What forms are carried in the pupa stage?

How do bees live through the winter? Have you ever seen bees flying during the winter?

A fine way to get acquainted with the winter life is to take a tracking trip just after a light fall of snow.

Make a record of all tracks found and identify as many as you can. Follow these to their feeding grounds and make record of food. You will be surprised to find birds feeding that you thought were away in the Southland. Make a record of these.

Study the tracks and try to determine whether the owners of the tracks were leisurely strolling, pursued, or pursuing.

What tracks of rabbits feeding? Study the rabbit and distinguish between cotton-tail and jack-rabbit tracks. From the food the rabbits were taking, decide as to whether they are harmful or beneficial.

How does your cat behave in the snow? How does your dog? How does the rabbit?

Study domestic animals; what ones give evidence of discomfort during cold weather; what ones seem to enjoy it? What does this tell you about their wild ancestors.

Find or draw pictures of the winter homes of ten animals.

THE COW.

Does the cow's knee bend forward like your own?

Has a cow a foot like a horse? Is it like the foot of a dog? Upon what bones of the limbs does the cow walk? Are her legs constructed like the horse's? Compare her gait and speed with that of an average horse. Compare the teeth of the cow with the teeth of a horse. Make a diagram of both the cow's and the horse's teeth for comparison. How does the cow eat? What does she eat? Find a picture of a cow's stomach and draw a copy of it showing route of food.

Make picture collection of various breeds of cattle.

Learn where each was developed and valuable characteristic of each breed. What is your favorite breed and why?

Make collection of related animals (cud-chewers) Note comparison of cud-chewer's feet as well as habit of feeding. What reasons can you find for these animals forming the cud-chewing habit?

Make trip to dairy to study proper care of dairy cows. Make trip to condensery and butter factory to learn proper care of milk products.

Why is milk the best food for growing children?

Why is the cow milked twice a day?

Why is extreme cleanliness necessary when handling milk?

What conditions are necessary for a prosperous dairy region?

MAN'S BEST COMPANION AMONG THE BEASTS.

How do dogs defend themselves and obtain their food? How do they escape their enemies? Study the structure of the dog's foot in relation to running and note chief means of speed and protection of foot. Study the feet of various breeds of dogs in your locality.

Study the various shapes of heads and the relation of these to the life of the dog. Watch a dog eat and explain why he eats as he does. Draw diagram of teeth, upper and lower, and explain method of eating in relation to these.

What is the natural condition of a dog's body when properly cared for? What does a very fat dog indicate?

What are the various gaits of dogs? Observe closely the action of the legs in walking, running, bounding and crawling?

What relation between the speed of a dog and its shape?

What traits and powers of the dog has made it the companion of man?

From the position of the eye is the dog's field of vision great or small? Has the dog a keen vision? What is the shape of the pupil of the dog's eye?

Why is the dog's nose always moist and cool?

What does a dry nose indicate? Of what use to the dog is its keen sense of smell?

How does a dog defend itself? Does he use his fore legs in fighting as a cat does?

What emotions have you seen a dog display? Does

he form a true attachment for his master?

How does he show his emotions?

Why does a dog bay at the moon?

How does music affect the dog?

Make a collection of pictures of the various breeds of dogs, study the chief characteristics of each.

Make a chart of drawings showing comparative shapes of heads. Also detail drawings of claws, teeth, feet, eyes, ears and legs of dogs. Study various coverings of dogs.

Compare dog and cat from careful observations.

Which forms attachment to master? Which to home?

Which enjoys cold weather? Which enjoys heat better?

Which sees better at night?

Which seems the more intelligent?

What is the difference in their claws?

Which is the better swimmer? Which likes water the better?

What are some of the uses man has made of dogs?

References.

- Bob, Son of Battle - Olliphant - McClure, Phillips & Co.
"White Fang" - Jack London.
"The Call of the Wild" - Jack London.
"Dog of Flanders" Ouida
Comstock - Handbook of Nature Study, pages 261-268

THE HORSE.

If the horse's knee corresponds to yours as to structure where is it found? Does it bend forward or backward? Upon what bone or bones of the limbs does the horse walk? Are there any other animals that have a foot like the horse?

What advantage is a foot like a horse's for its life over one like yours? Is it easy for the circus horse to stand on its hind legs? Watch and tell exactly how he does it. What advantage is the long legs of the horse? The long neck and head?

Give all the modifications of structure, that you have noticed among horses used for various purposes as draft horses, race horses, riding horses, cow ponies, coach-horses and plug horses.

Note the position of the horse's eyes and study its field of vision from their position. Compare with the position of your own eyes. Is the sense of sight keen or not? Has the horse a keen sense of hearing or not? What does the position of the horse's ears tell you?

How does the horse defend itself? Make a diagram of the teeth of the horse and explain their relation to its food.

Collect pictures of all the noted breeds of horses for a chart.

The horse has a wonderful history and many interesting stories have been written about it because it has long been the friend and companion of man.

Some references you will like to read are as follows:

- Comstock - "Hand book of Nature Study" - Pages 286-294
Hodge - "Nature Study and Life" - " 38-41
Ernest Seton/Thompson - "The Black Mustang" -
Roberts - "The Horse."
Warren - "Elements of Agriculture" - Pages 301-231

SERIES III.

1. How Birds Fly.
2. Sight and Hearing of Birds
3. Bird Songs and Call Notes.
4. The Common Brown Bat.
5. The Crayfish.
6. The Earthworm.
7. Snails.
8. Mussels.
9. Moles.
10. The Rat Pest.
11. Teeth of Animals.
12. Man.
13. Dickcissel or Black Throated Bunting.
14. Destructive Insects.
15. The Pigeon.
16. Fox and Gray Squirrel.
17. The Muskrat.
18. Native Fish.
19. The Stickleback.
20. Coverings of Animals.
21. The Salamander (Mud Puppy).
22. The Sphinx Moth.
23. Economic Value of Birds.
24. Protecting Our Trees.

25. Mother Love and Father Love in the Animal Kingdom.
26. Toads and Frogs.
27. The Frog.
28. Sight and Hearing of Birds.
29. The Mosquito.
30. Our Enemy, The San Jose Scale.
31. The Yellow Billed Cockoo.
32. The Humming Bird.
33. Whip-Poor-Will and Night Hawk.
34. Bird Characteristics.
35. Cockroaches.

HOW BIRDS FLY.

Field Study:

Choose five birds and watch flight. Keep record of all observations.

Note the difference in the manner of rising, the movement when flying, and the manner of alighting.

A few good examples to watch are: crow, vulture, night hawk, blue bird, cardinal, swallow, swift, gold finch, chick-a-dee, pigeon, chicken, guinea, and hummingbird.

Watch a humming-bird poise over a flower, easily and gracefully in mid-air. How does he do it?

Many chimney swifts may be seen flying in the evening and in the early morning. These are fine for study. They must have some method of rising straight-up from the chimney and dropping straight down into it. How do they do it?

Study adaptability of bird to overcoming air resistance: shape of beak, head, body, back, neck, breast, wings, tail and position of legs when flying. How do birds seem to float in the air? Identify five birds because of their peculiarity of flight. Why does the bird give a downward stroke? Do you think a bird could fly with its feathers removed?

Is the body of the bird heavier or lighter than the air it displaces? How would removing the tail effect the flight of the bird? How are the wings changed when brought forward for stroke?

Laboratory Study: Living pigeon or bird.

Note everything that helps to give the bird a wedge shaped form for cutting air resistance. Measure area of out spread wings. Compare with size of bird. Note shape and size of tail. Has shape of tail anything to do with character of flight?

Study feathers. Structure of a feather. (Draw) Study arrangement and kinds of feathers on body. Study various ways of molting. How are the wings kept balanced while molting? How and why does the bird preen its feathers? Where is the oil gland used for this purpose? Feathers are fine non-conductors of heat and cold. Why such fine covering for birds?

Take the temperature of the bird. Compare with temperature of man. Why is the bird's so high? Study relation of temperature to flight and amount of food consumed.

Secure bones of bird and compare with structure and weight of beef bones. Note air spaces.

Secure skeleton (Baked chicken or turkey skeleton), clean and study as to form and articulation, compare with human skeleton. Note attachment for great breast muscles. The keel shaped breast bone. The rigid back bone. What advantage is this for flight of bird? The long flexible neck. The place of attachment for the legs, to enable the bird to balance itself on two feet. The attachment of the tail to be used as a rudder in flight. In chicken or pigeon, find membranous air sacs.

Compare flying of bird in air medium with swimming of fish in water medium.

Compare flying of bird with kite flying.

Compare bird with structure of aeroplane.

Record:

Make drawings of parts studied.

Write up conclusions.

Record of all observations made.

Reference information.

Notes bearing on subject from references.

BIRD SONGS AND CALL NOTES.

Field Study:

How many songs and call notes of the robin can you distinguish? Of the cat bird? Of a cardinal? Of a flicker? Of a wren? Of an English sparrow? Of a night-hawk? Of a meadow-lark?

Make a list of all the birds you can distinguish by their calls.

What emotions cause a bird to sing or call?

Name the song birds of your locality?

Name the birds that do not sing.

Laboratory.

Secure a pigeon; chloroform; when dead, remove trachea (wind pipe) very carefully, lungs attached.

Find larynx at upper end, examine carefully, find the muscles that produce voice. Also examine the lower part of the pigeon's trachea and you will find the bird's second "voice box," called the syrinx. Open the trachea and examine this organ carefully. (Make drawings of the trachea of the pigeon showing the larynx and the syrinx. The muscles of the syrinx regulate the number of vibrations made when the air from the lungs sets them in motion. These give the pitch to the birds tones.

Try imitating some of the bird songs.

Some people can imitate many bird songs. Some are difficult to imitate by man because he does not possess the syrinx. You can easily imitate the cardinal so well that other cardinals are fooled. Try it.

COMMON BROWN BAT.

Field Study:

What flying mammal is often seen at evening?

Study bats at evening:

Note manner of flying; where seen, time, height, speed, ability to dart.

Why are they seen flying at this time and in this manner?

Are they ever seen flying in the day time?

Do they make a noise when flying?

How can you tell it is a bat?

Evidence that most superstitions are false.

Friends or foes of man? Harmful or harmless?

Give proof, from own observations, of conclusion.

What are their friends? Their enemies?

Habitat:

If you wanted a brown bat for study, where would you look for one?

Can you find out where the bats stay during the day? During the winter? Did you ever see one during the winter? How do bats rest and sleep?

Describe their homes.

Do they migrate during the winter? Do they live in single pairs or in groups?

Home life:

Have you ever seen them with their little ones?

How were they carried? How were they fed? Find proof of mother love; of father love. How many little ones?

What animal does it appear to resemble the most?

Laboratory Study: Living Bat.

Secure brown bat and place in glass jar for observation.

Discover five proofs that the bat is not a bird.

What senses do you find it using?

How blind is "as blind as a bat"? Make experiments to test vision, hearing, tactile sense and equilibrium. (Many experiments have been made with bats. They have been placed in room full of fine wires, the eyes removed so they could not depend on vision, then frightened to detect how they could avoid obstructions when in rapid flight. The conclusion reached was that the wonderful power of sensing obstructions lay in the keen hearing and a tactile sense in the wings.)

What sound if any do they make?

Note the rapid beating of the heart; count the beats under varying conditions.

Place stick in its mouth and count its teeth, noting differences, if any. What is the use of their molars?

From body structure, account for flight. Spread out the whole membranous portion and make a drawing of the same. What bones form the frame-work? How are they modified from the general type form of these bones as found in other animals? This hand-wing is a fine example of special adaptation. Adaptation for what purposes? Study structure determine all uses. Compare with a parachute. For what is the membranous extension about the tail used? How do bats

guide themselves in flight? Find the thumb. How does the bat use its thumb? With a thermometer, take the temperature of the air in the jar when the bat is calmly sleeping. Take it again when he is excited. Account for the high temperature when excited. By teasing him and getting him excited, watch his "playing possum". What pugnacious characteristics does he display? Try to make the bat walk. Can he do this? Note direction of knee. Why this position? How does the bat's wing differ from the bird's? Is the bat's wing well supplied with bloodvessels? Study the bat's feet, to determine their usefulness. Do they seem strong or weak? Do they indicate little or much use?

Locate pouches for carrying little ones. Examine both father and mother bat for these pouches.

Secure bones of a bat and compare structure with bird bones and with common meat bones. What differences do you find?

If desired a very interesting chart may be made, using skin, head, tail and wings of bat together with pictures of parts studied, pictures of food of bats and stories.

General Information.

Story of Mother Love.

A boy found a young bat, ^{and} was taking it to the museum, when he was attacked by the mother, who followed him for blocks, never relenquishing her efforts. So both were taken to the museum.

In Fort Scott, Kansas, there is no difficulty in securing all that are needed for study. An old deserted building has been appropriated by the bats for their quarters. And here at all times, an abundant supply may be had. Here they hibernate during the winter, hanging in great numbers from the beams and walls. Last autumn nine were secured from behind the pictures in the high school hall.

There are but few localities that do not have one or more bat communities.

All one needs to do is to start the boys looking for them.

Many superstitions prevail about bats and children are always curious about them. Children are much surprised to learn that bats are not birds but flying mammals. That they are not darting about at night for the purpose of tearing out their eyes, becoming entangled in their hair to give them bed bugs or looking to suck their blood, but are friends of man, devouring thousands of mosquitoes and insects.

References:

For verification of observations and further information,

The American Natural History, William T. Hornaday

Charles Scribner Sons,

New York.

Parker and Heswell, Text Book of zoology

MacMillan

THE CRAYFISH..

This homely but interesting animal is fine material for the study of living material, as it is large enough for handling and watching by all the class. It is easy to obtain material for each member of the class. Boys have always been attracted to this marvelous, fighting creature, chiefly, of course, to experiment with its powers to pinch, but they willingly turn to the study of its other curious powers and characteristics. One or two crayfish will thrive in the aquarium and their whole life history may be watched and the records kept.

Field Study:

Arouse interest by such questions as the following: What do you think of an animal that can easily grow a new leg if it happens to lose one? An animal that can grow a new eye, but experiments sometimes show that it may get a little mixed in what organ it needs and grow a **feeler** where an eye should be. You perhaps have found them growing a new leg. How long do you suppose it would take the new leg to catch up with the old one?, Experiment and find out. Have you ever found one changing its clothes?, You may have found the old, discarded shell on the bank of a pond or stream. By carefully examining these old shells can you tell how the crayfish gets out of it? What can you discover from this cast off shell about the color, material, and structure? It is said that the crayfish will purposely

throw off its pinchers if escape is impossible otherwise.

Have you ever seen the crayfish do this?

Where do you find crayfish? How do you find them hiding from their enemies? Where hiding? How do they face? Why? How do you suppose they detect the approach of an enemy, by sight, hearing, or vibrations in the water? What is the size of the largest one you ever saw? The size of the smallest one you ever saw?

Do you find the crayfish living together or each for itself?

Did you ever see a mother crayfish carrying her eggs or her little ones? How does she give them sufficient air? Have you watched her airing the eggs or little ones? Is she a patient mother? For how long does she show her mother-love?

What are its enemies?

What harm does it do?

What good does it do?

Is it of any use to man?

Laboratory:

Secure a mother crayfish with eggs or carrying her little ones. Place in large glass jar or aquarium. Have several inches of the pond sand, gravel, and mud in bottom with water to a depth of several inches. Some rocks for it to hide under if there is space for them. Water must be changed often according to quantity.

When she is escaping, how does she move? Watch closely and see exactly how she does it. How does she move backward so rapidly? Can you make her swim forward? Find all

the organs she uses in swimming and the purpose of each. When she thinks she is safely hidden watch and see if you can tell what organs are on watch. Note carefully her compound eyes, why do you suppose they are on stalks? Touch them and see what she does with them for protection. Compound eyes means many eyes in one. Why does she need so many? Do you suppose her vision is very keen? Give some reasons for your answer. Would she need keen sight where she lives or does she depend chiefly on some other organ to detect her enemies and find her food? What do you suppose she sees down where she lives anyway? Note two pair of antennae (you probably call them feelers), one pair so much longer than the other. What does she seem to be doing with them all the time? When you pick her up what does these long antennae do? Do you believe she has the sense of smell and taste? What experiments or evidence can you give for your belief. What do you suppose she eats? Give her some fish, a fish worm, a live and some vegetables and decide which she prefers. Try other foods when you know she is hungry.

Find all the crayfish's means of protection. What colors does the crayfish possess? Of what benefit are these to her? Has she any beautiful colors? If you pour boiling water on a dead crayfish will it turn red like its cousin, the lobster?

Does the crayfish have the power of feeling? What makes you think so? The short pair of appendages on the head are called antennules, scientists tell us these are

the organs of touch, and the second longer pair are the organs of smell and taste. If you will carefully remove these long antennae, you will find some tiny hard substance like tiny pebbles, these tell him his position, whether upside down or not. Lay one on his back and see him right himself.

Place some colored water just under the side of the shell that covers his head and thorax and see where it comes out, this tells you which way the water passes over his gills, for he is a gill-breathing animal. Raise the side of the shell and examine his gills. Here the blood from his body meets the water, carrying oxygen, oxygen is exchanged for carbon dioxide to help purify the blood.

The mother usually lays her eggs early in the month of April and attaches them to her swimmerets, here they hatch, she continues to carry them for several weeks until they are better able to care for themselves. They have many enemies and great numbers of them are devoured.

Crayfish live to be about three years old. They are devoured by fish, kingfishers, mink, otters, man and often by themselves.

What part of the crayfish is edible by man?

Weigh a crayfish, take out the edible part and find out how much edible meat in a pound of crayfish.

What is this meat like? Could crayfish furnish food for man?

General Information:

Crayfish are being raised as food in some places to supply the demand for this kind of food that its cousin, the lobster, can not supply at the present time.

Crayfish sometimes burrow into dams and dykes and cause great injury. In Mississippi and Alabama they have damaged great areas with their "holes" so that they have become a great pest. Hegner tells us that as many as ten thousand crayfish holes have been found in an acre of land. The farmers have had to resort to various means to destroy them, poisoning them with carbonbisulphide and by various ^{other} methods of killing.

THE EARTHWORM.

Living Worm, Field Study:

Do earthworms rain down? Study earthworms after a shower and in the soil.

You have noticed the great number on the walks, ground and street just after a shower. Where did they come from and why did they come? Superstition says they rained down, some people say they rained up by being drowned out. Oswald H. Lotter tells us that "The earthworm seldom leaves his burrow when perfectly well and healthy. Those seen crawling after a rain are usually infected by the larvae of parasites and doomed to die!" Do you find any evidence of this? Take some from the ground and place these and also the ones found on the walk, mark them so you can distinguish them apart, and place in water to see if the earthworm can live in water. Note time they live and compare with time earth was saturated. The process of getting oxygen for the blood has much to do with whether they can live in water for any length of time. Consider also the food problem. Have the earthworms homes? Have they the homing instinct? Try an experiment to find out. Watch some after a shower and see if they seem to know where they are going, or do they act as though they were lost? How do earth worms descend into the ground? Take up a spade full of various kinds of soil as sandy, loamy, clayey, dry and moist, counting the earthworms in each kind. Repeat this several times and try to decide whether there is any relation between the number of earthworms and the quality of

soil. Go out early and count the little earth's mounds, found in a given number of square feet. Examine the soil around the earthworm's burrow and see if you can detect a slimy substance. Where does this come from? Examine the earthworm carefully and see if you can account for it? Does this affect the soil in any way? Go out after dark, with a flash light and see if the earthworms are out and what they are doing. Lay off a section of ground, cover with leaves, examine the leaves every day and see if they show signs of having been eaten. Do you find earthworm's mounds under the leaves? Dig into a burrow and see if any leaves have been dragged into it. How is the burrow lined? How deep is it? Do you see earthworms coming out of the ground during the day? Do you believe them to be nocturnal? Try to find proof as to whether they are or not.

Laboratory. The living worm.

Place in plate with enough water to keep them moist and watch them move about. Describe motion. Examine with simple lens and endeavor to find out just how they move. Rub your finger along under side of body and note what you discover. Turn the animal over and watch him right himself. Watch the movement and decide as to whether the animal has muscles or not, and if so how they extend. Find the head of the animal and study the mouth. If possible, watch it eat. To do this place some on soft, moist earth and feed lettuce or cabbage leaves. How can you distinguish the head from the tail? Can you find any evidence of teeth? Hold the worm up to the light and you can tell quite a little about

his internal structure. What do you find in his digestive tract? Do you find anything that appears to be a blood vessel? Can you see any enlarged places in this vessel? What is peculiar about these enlarged places? In what direction do these contractions pass? Place the earthworm in water over night; what internal structures can you detect then? Can you make any tests to tell whether the earthworm can distinguish dark from light? Place the head in the dark and the caudal end in the light and see how rapidly it moves toward the dark. Place the caudal end in the dark and the head in the light and see how rapidly it moves toward the dark. Watch this reaction to light several times. Find by experimenting which parts are the most sensitive to light, to moisture.

Make a careful drawing about twice the size of the worm showing all the exterior markings and openings you can find by the most careful observation. Use hand lense if you have one. How do you suppose the earthworm takes in oxygen for its blood? Do you find any gill openings as in fish, or spiracle openings as in insects? From your worm left in water, make a drawing of its internal structure as far as you can make out. Do you find a light band about the body of any of your earthworms? If so, this is called the clitillum and aids in forming the ^{cocoon} of the earthworm. Do you find various sizes of earthworms. Earthworms have the power of regeneration, that is, the power to grow again part of the body that may ^{be} cut off. Earthworms cut in two, often develop into complete worms. Cut off the head and a few segments, place

the earthworm in loose, moist soil and see how long before it has a new head. Examine daily. Do you know any other animal that can grow a new member of its body when one is lost?

General Information:

Where do earthworms go during the night? During the winter?

Are earthworms, friends or foes of man? What does the earthworm do for the soil? Why did the Indian say, "No worm, no plant."?

On a warm night hundreds may be seen anchored to their burrows by the little hair-like cetae near their tails, and feeding on the surrounding vegetation. They graze in a circle like a cow at the end of a chain. The muscles of the lips and pharynx suck the surrounding vegetation to the burrow, over this they discharge a secretion of an alkaline fluid which softens the leaves and discolors the leaf tissue. Fragments of these softened leaves are sucked off and swallowed. They have no teeth but sand in the digestive tract crushes the leaves into a soil like mass, this is mixed with the digesting fluids and the secretion from the calcareous glands, which improves the soil, and it then passes from the body forming the little mounds we so often see.

Most nature books will give you information about the work of these creatures.

After your investigations, it will be profitable to

read these.

Keep a record of this reading. Name of author, name of book, name of publisher and pages where information is found.

Make notes on important findings.

THE SNAILS.

You have all heard of, "as slow as a snail", how slow is that? Who can find out?

A few snails in an aquarium, if pond snails, and a few on a moist plate if land snails, will afford endless study for keen boys and girls.

Just how a snail walks with only one foot, and how a head as small as a snail's can possess a tongue that can penetrate hard shells are facts worth proving. Its eyes too are interesting as well. Just how well developed they may be can be tested out by the observers.

The process of folding itself up and retiring within its shell, and then appearing again affords points of observation.

If land snails, how do they manage to live out of water?

Make collection of snail shells in locality and see how many variations can be found.

Field Study:

Where do you find land snails? Where fresh water snails? Secure some of each if possible. Are they usually found out of their shells or within the shell? What is the difference between the shell of the garden snail and the pond snail? Are the spirals of all shells turned in the same direction?

What has the land snail had to do to adapt its life to a terrestrial habitat? How does the snail build its

shell? Do you find shells differing in size.

Have you ever seen the snails eating? If so describe how they eat? From watching snails moving and feeding, what senses do you conclude that they have?

Can you find proof as to whether snails are friends or foes of man?

Where do pond snails get the material for their shells?

Where do garden snails get the material for their shells?

Laboratory:

Secure a few pond snails. Place in water for observation. Place a little food in aquarium or glass jar containing snails. This food may be algae and ^{other} water plants.

Observe snails crawling up the glass and determine method of locomotion. How many organs of locomotion? Of what composed? Where does the movement begin? How does the movement proceed? What trail does the snail leave behind it? What is the substance? What is its use? Does it come from the front part or hind part of the foot? What is as slow as a snail? Measure off a certain number of inches and see how long it takes the snail to cover the distance. Estimate the rate in a minute.

Feed the snails a piece of cabbage leaf or a piece of apple and watch how it eats. Remove the food and look closely at the tongue. What do you find? Use a lens and see if you find the little spiny protuberances on the tongue. Would you like to have the snail lick your finger with this tongue?

Examine the edge of the shell and see if you can find

the breathing pore. How is the snail fastened into its shell? Do snails breath with gills like a fish or with lungs as you do?

General Information:

If you examine the common garden snail, you will find that the spirals usually turn to the right although you may find a few that turns to the left.

This shell is formed by a secretion from a gland situated near the thickened edge of the mantle known as the collar. It secures the lime and other material from the water and other things taken in with its food. It can secure this material only in limestone regions so snails are not found in other regions. These animals are naturally water animals and when they forsook the water for land their habits and structure changed in order to meet the new conditions. The snail must keep its body moist, this is done by the mucous substance secreted by the mucous glands which lie in the skin and by conserving this by the shell. The snail begins to form the shell at the apex and enlarges this as it grows.

Garden snails become active only during damp weather or dawy nights or when there is no sun to dry up their bodies. When placed in a dry vessel they retire within their shell and remain until water is placed in the plate, when they slowly emerge and begin active life. In nature when the dry conditions come on they retire within their shell, form a hibernaculum and await more favorable times.

Shells are a protection against evaporation, enemies or mechanical injury.

The snail is fastened to the shell by a muscle called the columellar muscle which runs along the inner side of the spiral of the shell and is fastened by tendons to the columella in the upper part of the first turn. The columella is that portion of the shell where the spiral begins. From where the tendons begin strong muscles pass down into the foot. It is by the contraction of this that the animal is withdrawn into its shell.

The speed of the snail is slow but sure. It would require about fifteen days to go one mile if it traveled at its greatest speed without stopovers for food and rest. Its movement is a slow gliding one, produced by the action of the muscles in the foot, cilia, minute hairs and a mucous substance secreted by glands near the front of the foot which makes a slime for it to glide in. The slime can be seen left as a trail after the moving snail. Movement seems like a ripple in the spread out foot. You sometimes find these tracks on algae growing on trees. Snails have a sense of direction and a homing instinct for they can find their way back home. Experiments might be made to determine how far from home they could wander and yet get back.

The most interesting thing about the snail is the way it feeds. Its food consists of tender succulent shoots, the saccharine portions of the plants are preferred and unerringly selected. This shows that the snail has a "sweet tooth." Place a bit of tender cabbage or a piece of apple near the snail's head and watch him eat. Remove the food and examine the action of the rasping tongue. Use a hand lens. The

tongue, called the radula, used for scraping off fine particles of the plant is very wonderful instrument for its size, as it is said it can successfully "rasp" through an oyster shell in time. The radula, or "lingual ribbon" is a horny ribbon-like structure covered with an immense number, about 15000, minute backward pointing teeth. It is easiest studied in snails crawling on the glass surface of an aquarium and feeding on microscopic ^{algae}, the radula is pushed forward and makes an upward rasping stroke, by this movement the algae is torn off and rasped against the jar. The interior portions of the radula are continually being worn off and constantly replaced by fresh growths from behind. The growth takes place in the radula sac which is found in the back of the mouth cavity.

From this sac, the radula constantly grows forward keeping up a fresh supply of teeth through life.

The snail has an entirely different breathing system from the insects or mussel. Instead of spiracles as the insects, or a mantle cavity filled with water like the mussel, the snail has a sort of lung. Air is taken into and expelled from this cavity, and the exchange of oxygen and carbon dioxide takes place between the air inhaled and the blood in the blood vessels of the surrounding mantle.

From what has been given it will be seen that the snail is endowed with a number of senses.

The sense of sight is not highly developed as an examination of the eyes to be found at the outer end of the two great tenacles, protruding from the head, will show.

Probably they do not distinguish much more than light and darkness. The sense of taste is shown in the selection of food.

The sense of direction, in homing instinct.

Tests may be made to determine if the sense of hearing or the sense of feeling vibrations is present.

Snail's eggs are laid in July and August in moist earth under heaps of leaves and stones. They are enclosed in a tough calcareous shell. They are about one fourth inch in diameter, twenty to sixty in a batch and hatch in forty to seventy-two days.

Snails reach maturity in about three years and usually live about five years.

Their enemies are rats, field mice, hedge-hogs, birds, frogs, toads, fish, beetles and ants.

Some species are used for food.

The pond snail is generally about the same but the habitat is water.

MUSSELS.

Field Study:

Did you ever see an animal moving along with only one foot? Watch along the muddy edge of a pond or river and you may see one.

If you find one, note whether the stream is rapid or sluggish; shallow or deep; muddy or sandy bottom. Did you find any tracks it had left? When not moving does it lie on its side or maintain an upright position?

Study its movement and see if you can discover how it moves along. Does it move slowly or swiftly? Did you find any with the valves remaining open?

Laboratory Study:

Secure one or two, keep in water and bring to laboratory for study. Place about two inches of sand over bottom of aquarium and put in the mussels. Lay them on their sides and see if they right themselves. Watch to see them protract their foot and walk. From which part of the shell does the foot protrude? What is the use of the shell to the mussel? Is it fine for the purpose of not? Are the two parts of the shell alike? How are they fastened together? How is the shell built up? Where does the mussel begin building it? What do the rings indicate? Are they all the same width? What part of the shell is the youngest?

Does it require much or little strength to separate the valves? Pick up a shell with the muscular foot protruding and see what happens. What does this action indicate? Do

you find any evidence of a nervous system? Of what substance does the shell seem to be made? How does the mussel obtain this material? What kind of water is necessary for the mussel's home? Examine a shell carefully, how many layers can you find? How do they differ? Break a shell in two and study structure. What markings do you find on the inside? What can you tell about the building of the shell by these markings?

Take a newly opened shell and notice the soft material attached near lower edge. This is the mantle. Follow this mantle around and find the place where the water enters the shell. Place a drop of dye or ink at the posterior end of living mussel and you will discover where the water enters and leaves the shell to give the mussel oxygen for its blood and food.

In the open shell find the gills lying between the body and the mantle.

Do you find a mouth anywhere about the mussel? What do you suppose he eats?

What senses do you suppose it possesses? Can you think of some experiments to test for certain senses? Touching shell. Touching foot. Throwing light on mantle. Placing strong chemicals in the water. What is the only way it can indicate ^{that} it receives a stimuli?

Have you found various sizes of mussels?

What is the very smallest one you ever found?

Do you know the life history of a mussel?

It is such a peculiar one, I am afraid you will have to go to

book for that information.

Of what uses, if any, are mussels?

Read on the button industry.

Lime and fertilizing industries

"Mussel Shoals Island"

How do they aid in purifying water?

To what animals are they closely related?

MOLES

STUDY FROM LIFE.

Have moles eyes or have they not? Do they need eyes in their natural habitat? Catch one alive, does it distinguish light from dark? What makes you think so? Search carefully for eyes or vestiges of eyes.

Man believes the mole to be an enemy, Is it or is it not? How can you find out the truth about this matter?

What is the food of the mole? What can it find in the ground to eat?

What is the shape of its head, its nose, and its front feet? How about its neck? Why? Are its legs long or short? How do the front feet differ from the others? Are the muscles and tendons well developed in its fore limbs? Why? Do you suppose it is hard work for the mole to dig its tunnel? Test a mole's digging power by placing it on some ground, where it cannot escape and timing it. How long does it take it to completely cover itself? How long does it take it to dig a foot?

Sometimes it seems to be a pest for it digs where digging is not wanted. The best way to stop its digging is to press down the soil.

France protects the moles by law. Why?

The mole is a mammal with beautiful fur.

THE RAT PEST.

What first hand evidence can you find proving the destructive nature of the rat or mouse? Can you find any evidence of beneficial work? Describe some of their habits. What varieties are there? Why should a concerted, general campaign for the extermination of rats be made? What are the best means that you know for their extermination? What do you know of their breeding habits that accounts for their great numbers? How many litters of young may they have and how many are usually found in a litter?

What experiences with rats indicate that they are usually able to care for themselves and therefore increase very rapidly, and foil man's plans for their destruction? What are some of the food stuffs that rats are found destroying? Do you know how rats can steal eggs and carry them away unbroken?

What are some of the relations between rats and diseases of man?

Why is a person ^{who} allows rats about his place a poor citizen?

What are some of the measures suggested for the destruction of rats?

What does the government advise to control the rat pest?

Read the article in the "National Geographic Magazine" for July, 1917, "The Rat Pest."

TEETH OF ANIMALS.

Why are the teeth so often the only remaining evidence of animal life? What are some of the characteristics of the animal we can determine from the teeth? Why have you several different forms of teeth? Suppose all your teeth were like your front teeth, how would it effect your chewing? Suppose all your teeth were like your molars, how would it effect your chewing? Do you find any animals with all their teeth alike? Study carefully the cow's teeth and decide on the relation between the kind of teeth and the food. How do you account for the vacant bar between the horses' front and hind teeth? Why does the rabbit need to sharpen its teeth so often? What animals have teeth like the cows? What animals have teeth like the horses? Like the dogs? Like the rabbits? Like the sharks? Like the lions? What general form of teeth are found among the herb eaters, the gnawers, and the grain eaters?

How do some of the animals care for their teeth?

How do teeth differ from bones?

MAN

What animals have a skeleton somewhat similar to man's? How does the hand of man differ from all other animals' fore paws? What advantage has the man's hand? How does the balance of man's head differ from the balance of the animal's head with regard to the relation of the back bone? How does the general form of the vertebrae of man differ from the vertebrae of other animals? How does the pelvic girdle of man differ from that of other animals? How does the foot of man differ from that of other animals? Of what advantage is the arch of the human foot? Do you find any other animal with an arched foot? When man steps, where does he place the fulcrum? Do you find any other animal using this same toe for a "throw off" for its step?

Is there any other animal with a skull shaped like man's? Do other animals give evidence of a memory? What ones? Give examples.

Do other animals show emotions similar to man's? Give examples.

What animals, that you have studied, seem to have the highest emotions? What animals, that you have seen in shows, seem to be capable of taking the highest training?

What natural means of defence has man? How does man defend himself? Compare with some of the natural means of defence of some of the other animals? Are the special senses of man superior to those of all other animals? What animal that you have studied had a sense superior to that of man?

What has made man superior to all other animals in his struggle for existence?

Make a list of all the physical characteristics in which man is superior to all other animals you have studied.

Wherein lies the differences between the various races of man?

Is man subject to the same physical laws as other animals?

DICKCISSEL OR "BLACK-THROATED BUNTING."

The little dickcissel seems to love to sway and sing. On weeds in pastures, on telephone wires and bending twigs may be seen this little fellow, and may be heard his oft repeated song, calling attention to himself, "Dick, Dick, Cissel, Cissel," Most birds cease to sing after the nesting season but the dickcissel sings as long as he remains with us. He is very pleasing and seems much awake and in earnest about his song.

His colors are a perfect blending of the prairie tones, with touches of yellow, brown and black. His breast is yellow and he can be identified very easily by the black patch on the white throat. This gives him the name of the black throated sparrow. In size he is about as large as the English sparrow.

female

The/closely resembles the female English sparrow, and is very quiet and shy.

These birds are seed eaters so have the conical beaks. They destroy great quantities of weed seed for the farmer.

They nest low usually preferring the buck berry bush. The nest is well built, cupshaped, and made of grass, fine twigs and roots. They have four or five light bluish green eggs. The cowbird seems to be very fond of laying in these nests for their large brown speckled eggs are so often found in them. The nest is not difficult to find. If you drive across a pasture and come near a

nest, the dickcissels will fly up and by their very manner tell you that if you search you will be rewarded. They are so numerous that it is easy to locate several in a short time.

In the fall, they gather in flocks and migrate, alighting on our prairies to feed as they move southward. They are a live bunch when moving for the ones in the rear are continually flying to the front as though the leaders were too slow. They seem very sad when leaving their summer homes and remain quiet while on the march. Early in the spring, the males appear a few days ahead of the females and again our prairies ring with their cheery notes.

DESTRUCTIVE INSECTS.

One of the pests that the housekeeper, the clothes merchant, the furrier, and the keeper of the museum must be on the watch for is the clothes moth, so insignificant in looks but so destructive in habits. It is a very small insect, a moth, dirty brown in color, and about one half inch across the wings. The under wings have a few dark spots. They should be killed whenever found. The moth itself does not eat for it has no mouth parts but the female of this moth may lay many eggs which will hatch into larva that feed upon various kinds of wool and fur.

Each boy and girl should keep a few of these in a closed glass jar to study their habits and life history. Look about the attic or the storehouse and see if you can find some material that is breeding these pests. The eggs are tiny white specks so small you will need a lens to discover them. The little larva spin a cocoon as they feed and grow. They enlarge the cocoon at each end as needed, when it becomes too tight, they enlarge it by splitting it and putting in little gores. An interesting experiment is to change the color of the material on which they are feeding and see the change it makes in their cocoon.

Many a housekeeper has carefully sealed her precious garments up in a moth proof bag or cedar chest in the spring and found them completely ruined in the fall. In this case the eggs were already laid in the garment and the larvae hatched and enjoyed the feast unmolested. When the larva

reach their full growth, they enter the pupa stage and remain quiet for about three weeks, then hatch into the moth stage. The moth flies about for a short time, mates and the female lays her eggs and dies. The eggs are laid from June to August. Each female is capable of raising one brood each season.

There are two other species that are quite common, the southern clothes moth, which is a pale straw color, without spots and the tapestry moth which has the half of the fore wing next to the body black and the rest white.

The tapestry moth is most liable to attack museum specimens. The fine bird collection at our "Public Library" shows the awful destruction of these moths.

If we permit our old garments to become breeding places for the moths we are not good neighbors, for moths have wings and will not always remain in old cast off garments. They are like the seed of the dandelion, if one neighbor has them the whole neighborhood is liable to have them.

THE PIGEON.

Field Study:

Notice the feet of the pigeon and decide its feeding habits. Notice the bill. Make a drawing of each. Watch pigeons for a week and make a record of all foods you see them eating. How do they fly? Do they use their tails when flying? How do they arise? How do they alight? Are pigeons social birds or do they prefer living in pairs? How many eggs are laid? How long are they incubating? How do the parents care for the young? What sounds and calls do pigeons make? Are the young able to care for themselves soon after hatching, like the quails or not? How do the parents feed the young? Have you ever seen the parents obtaining worms for the young? Note the beautiful colors of the pigeons. Describe ~~the~~ several that you think especially beautiful? Do pigeons like the associations of man? Give proof as to this. Are pigeons friends or foes of man? Give proof for answer.

Laboratory:

Living pigeon for study. Examine beak carefully and decide what kind of food it is most suited for? Where are the nostrils placed? Examine the eyes. How many lids and where situated? Can the pigeon wink at you? Note the external arrangement of ear. Does it seem to have a keen vision and a keen hearing? Examine the different kinds of

feathers and the location on ^{the} body. Draw the various kinds and explain relation of structure to purpose they serve. Pull out one of the large wing feathers, note the expanded portion, the vein, supported on the hollow quill and strengthened by a central axis, the shaft. On each side of the shaft are the barbs, from which still smaller structures called barbules extend. Examine these with lens and describe the way they are related to each other. Of what use is this arrangement to the pigeon? Suppose your hair was similarly arranged? Study the feather arrangement on the wing. Why primaries on the hand part of the wing, secondaries on the forearm, and tertials on the upper arm? Bend the wing at the joints and determine how many large feathers on each division of the wing. Raise and lower wings and study structure for flying. Fan above and below and note manner of raising and lowering wing.

Examine legs as to position of toes when standing, perching, and flying. Note covering of feet and leg. Resembles the covering of what animal?

Examine attachment of legs to body, and note body structure that permits the flight. How does the back bone and pelvic girdle differ from that of man?

Compare the breast bone of the pigeon with that of man. Note the great muscles that move the wings.

Secure pigeon bones and compare with beef bones as to structure.

Reference.

Comstock - Handbook of Nature Study - Pages 45 - 47.

FOX AND GREY SQUIRREL.

Where are the members of these families usually found? What is the most common haunt of the fox squirrel? Why? Which of these squirrels ^{are} most abundant? Why? Which has the better disposition? Is this an advantage or disadvantage to the squirrel?

When is each of the squirrels the more active? What is the food of each? Where do we find the homes of each? Does each store up food? Where are their store houses and what do they store? Are they personally cleanly? Did you ever see one perform its toilet? How many broods have each during the year? How many young in each brood? Describe the voice of each species. What are the enemies of each? Each of them are enemies to what? How does each defend itself? Where are they common? Do they hibernate or are they active all the year? Are they valuable to man? Are they valuable in the scheme of nature? Do squirrels make good pets for children? Are they beneficial when running at large in a city or city park? Why are they some times very dangerous? What are some of their special characteristics? To what class of animals do they belong? Give examples of their intelligence. How do they use their fore feet? Their hind feet? Of what use is their large bushy tail? Do their eyes indicate that they are hunted or hunters? Secure one for a few days for laboratory study. Give proof as to whether they are friends or foes of man. Are they protected in any way by our State Game Laws?

MUSKRAT.

Musk rats are very abundant along our water ways.

Do you know the tracks of the muskrat when found in the mud? When are you most apt to see the muskrat and where? What is their food? Have you ever seen them prepare their vegetables? Track one to its home. How does it make its home? Does it store food for winter? Does it hibernate any part of the year? How many broods does it have a year? How many in brood? How does it care for its little ones? How long does it take the young to mature? What kind of a voice does it have? What are its enemies? To what is it an enemy? How does it protect itself? Where are its ranges? Is it of commercial value? What harm does it do? Of what value is it in nature's scheme? To what class of animals does it belong? What is its covering? How does it use its legs? What animals does it most closely resemble? Describe it.

References.

- Comstock, - "Hand book of Nature Study" - Page 218-223.
Lottridge, - "Familiar Wild Animals"
Cram, - "Little Beasts of Field and Wood."
Burroughs - "Squirrels and Other Fur-bearers."
Long, - "The Builders" in "Ways of Wood Folks."

NATIVE FISH.

If several balanced aquaria are prepared early in the spring, there will be no difficulty in securing several varieties of the native fish for study.

"What fish will the natural boy naturally bring first?" Usually the bull head or mud cat, an ugly little creature but very interesting to watch and study. We kept a small one, about four or five inches long in an aquarium with several large tadpoles just ready to make their metamorphosis into frogs, and the bull head regularly made his dinner off of their tails. We found it such a voracious creature that we could not keep it with our other fish. The pupils discovered that only the bass could keep out of his way.

These are easily caught when they first come forth in the spring. Many interesting facts about the life of fish may be learned from them. Study their color and lack of scales in relation to their natural habitat. How do they defend themselves? How do they swim?

Draw the bull head's profile view and also direct frontal view. Label all parts.

Place some mud in the aquarium and watch his reaction.

Can you find out why the bull head can remain out of water longer than other fish? Test this fact by taking several out of water for a few minutes and then replacing them. Gradually lengthen time out of water until you

discover which can remain out the longest time?

Have you ever found a bull head's nest? Have you seen the mother bull head with her school of little ones near the bank of a stream? Do fish usually protect their young for a time? Do fish lay many or few eggs?

Read up on fish hatcheries.

Make a record of all the interesting discoveries you make about the bull head.

Reference.

Comstock's - "Handbook of Nature" - Page 154- 157.

David Star Jordan, "Fish Stories."

THE STICKLEBACK.

What fish, two or three inches long, arrays himself in a very gorgeous spring suit? Watch along our little streams and rills and when you discover the little creature with his red, green, and purple fins, secure a few for the aquarium. He is a beautiful little object as he darts rapidly about the aquarium. The female wears the sober garb of the average minnow. He is a ferocious little beast and makes it very uncomfortable for the other fish or life in the aquarium.

If you secure some of these early and place in a balanced aquarium, containing algae, you may see the glorious little fellow build his nest and prepare to do a father's duty toward a family.

If you live near a stream where he is found, study him in his native habitat. Look for the tiny nest, about the size of a marble, made of "frog spittle," algae, and attached to some water grass on plant.

Watch him through the spring and see that he changes his brilliant colors for a sober dress like the female, when family cares are over.

His life in the aquarium is interesting to watch. His structure to adapt him to protect himself and live are attractive to pupils.

Why does he and all fish float ventral side up is the question the pupils may seek to answer.

The proper care of the aquarium with the reasons for same is valuable dynamic teaching.

Other fish that will probably be brought for study are the minnow, sun perch, sucker and bass.

Make comparisons of structure and habits.

Draw, showing variations in general structure.

Reference.

Comstock's - "Handbook of Nature" - pages 153-180

COVERINGS OF ANIMALS.

What is the covering of the insect and crustacean?

Describe the material. Does it form a complete covering? How is it arranged to permit movement?

What advantages does it possess over some other coverings? What disadvantages?

Are all fish covered with scales?

Are all scales alike? What do scales resemble?

What commercial use is made of scales?

Are scales admirable covering for fish? What advantages do they possess over chitin or shell?

What is the covering of snakes? What advantages has this covering for the life they lead?

What advantages have feathers for the coverings of birds? What are the parts of the feather? Make study of feathers from different parts of body. Why the difference? Draw parts of feather, label and explain purpose of structure.

Why are feathers preened? Why oiled? Why on a cold day do the birds fluff up their feathers?

Make a collection of bird's feathers found, identify each and arrange on chart.

Advantages of fur as covering. Why the various kinds? Difference between hair and fur as covering?

Shell coverings. Advantages? Disadvantages?

Make chart of various kinds of covering.

Commercial value of shells great or small?

THE SALAMANDER (MUD PUPPY) NECTURUS.

Look along the rocky streams, near the river, early in the spring and see if you can find a little animal having four feet, placed almost on the sides of the body, a long fish-like tail, with out a fin, and head resembling a lizard's. It may have red, gill-like structures on either side of the neck. These can be found along our streams and are fine to study. They can be kept in the vivarium at school for a time. It feeds chiefly on animal life which it secures from the underside of the leaves of water plants so it will be well to bring in some water plants with the animal. It is nocturnal in its habits, and very secretive, therefore, rarely seen so this has given rise to many superstitions concerning this little creature.

If we secure one for study we will be able to disprove many of these false reports.

The study of the little animal alive is far more interesting than the study of one dead. If we secure one of the kind that has his gills on the outside it is very easy to watch the blood come for its supply of oxygen.

He is a near relative of the frog, and swallows his air in the same way, but we will find many differences between him and the frog.

How do you suppose he secures his food. Will his eyes help you to find out.

How do you think he is able to escape his enemies?

Note the glands on his back that secrete a slimey

substance. What does his covering tell you? Study the general structure of his body. How does he use his tail? Note the attachment of his legs. What do they tell you about his speed?

Open his mouth, with a stick, and examine tongue and teeth. We may watch him eat.

Are these creatures harmful or harmless to man?

Do they play a very important part in nature's scheme?

Why are they so seldom seen?

Find some of the superstitions concerning these creatures.

THE SPHINX MOTH.

Early in the fall, the larvae of the five spotted sphinx moths are very abundant on the tomato plants. It is commonly called the "tomato worm." This makes a fine specimen for studying the life history of insects. Some of the larvae will be found with little white bodies protruding from their backs, these are the ones that have been used by the ichneuman fly to rear and care for her young. These form a fine basis for a lesson on how nature keeps a balance and how man has made use of this method to destroy many destructive organisms.

Place some of the healthy caterpillars in a jar partly filled with soft soil and feed daily with fresh tomato leaves. When full grown, these will descend into the soil and form their pupae.

The diseased ones should be placed in a covered jar. In a few days the ichneuman flies will emerge from the silken cocoons on the back of the sphinx caterpillar, and be seen flying about in the jar.

Remove the healthy cocoon, carefully, from the soil and examine. Make drawings of all stages. Note all the parts of the moth that can be identified in the cocoon. Return to soil and keep in cool place until spring. Then place in breeding case and await the final metamorphosis.

These pupae are often found in old gardens in the spring and brought ⁱⁿ for study.

There will issue from this one of the beautiful sphinx

moths, so often seen flying about flowers of an evening, and called by many humming birds. This has given the creature the name of humming-bird moth. (Draw head and complete insect) Look for these about flowers at evening. Make a collection of the various varieties of sphinx moths. How do these moths obtain their food? Of what does the food consist? Watch them poise above a flower, how do they do it? What is the purpose of the adult moth? Why does the moth fly at evening? Why are they attracted to lights? What is the purpose of the furry body? What is the difference between the covering of its pupal ^{case} / and the covering ~~thex~~ of ^{with} the silk/family cocoon?

Give a reason for this difference.

Compare moths and butterflies in likenesses, in differences.

Name some beneficial moths - some harmful moths.

Give methods of destroying harmful moths.

ECONOMIC VALUE OF BIRDS.

To watch a bird feeding for a day will lead to a better understanding of the value of some of our birds, ~~by~~ seeing the amount of noxious weed seed destroyed or the number of insects devoured will cause us to put a higher value on our bird friends. What is the value of the quail to the farmer? The yellow-billed cockoo to our forest trees? The swifts to our own health and comfort? The humming-bird to our flowers? The owls to the destruction of our mice and snakes? The hawks to field mice? The verios to foliage insects? The vultures to the removal of carrion? And a host of other benefactors of mankind?

The agricultural departments of the nation and the states have made many studies of the economic value of birds and have issued many bulletins on the subject these may be secured at a very low cost or for nothing and the food charts of most of our birds obtained. Secure these and make up a chart of the common birds of your locality showing comparative value of each.

Study means of encouraging valuable birds in your locality.

Secure game laws and see if you can discover any places where they are disobeyed.

Organize Bird Protection Clubs.

Make list of trees and shrubs that furnish winter food for birds.

PROTECTING OUR TREES.

Make a survey of your neighborhood and find all the evidences of disease and destruction among trees. Bring the evidences to school and from the teacher, reference books and others find out the causes and remedies.

BAG WORMS.

Bring in twigs on which bag worms are found. Make collection of every kind of plant that you find as host to this destructive agent. Find the most common host. Make survey of the damage done by these pests the past summer. Open the bags, if female they will be found to contain hundreds of eggs ready to come forth next season for further destruction.

From Superintendent of documents, secure government bulletins concerning the life history and destruction of the bag worm.

Make instructive chart showing bags on hosts, life history (drawings and paintings) pictures of trees denuded by pest, information from bulletin and any other interesting information.

Organize bag worm destroying contest.

MOTHER LOVE AND FATHER LOVE IN THE ANIMAL KINGDOM.

What examples of mother-love and father-love have we among fish?

Find examples and extent of parental love. Why do fish lay such great quantities of eggs?

What relation do you find in the animal kingdom between number of eggs and parental care?

How far does the insect care for its young? Give various examples.

Give the amount of parental care of the crayfish.

Give the extent of parental care in the frog or toad family.

With what class of animals does parental care become the general thing?

Do all birds care for their young? What birds are soon able to care for themselves? Give examples of parental care of birds. What birds are hatched in the most helpless condition? What examples can you find of the father bird setting?

Is there family life among the bats? To what extent?

What is the usual home life in the spider family?

Why is the male often more highly colored or more decorated?

As animals develop, what do we find about family life and parenthood?

Give examples of home life that have come under your observation.

TOADS AND FROGS.

Among our most interesting material for study will be found the life history of toads and frogs. They make an especial appeal to children, the material is easily obtained and cared for, every stage in their life history may be observed in the school room and in their development they stand midway between the lower and higher forms of animal life.

THE TOAD.

While wandering along the margin of some quiet, shallow water in the early spring, even as early as March in our locality, you may notice some gelatinous ropelike masses entwined about the grass, twigs and water plants. Examine this mass closely and you will discover hundreds of minute eggs. These are toad eggs. In a vessel of the same water, take a few for the school aquarium. Many teachers have difficulty in having their eggs hatch and develop. This is due to overcrowding, lack of sufficient air, wrong kind of water and often placing in too strong sunlight. We have never experienced any difficulty when our aquarium was arranged with shallow water at one end and sand and stones at the other; only a few eggs and some oxygen producing water plants. A very few eggs in jars for each pupil will add interest. A simple microscope will aid in the study of detail in the various changes. Algae and water plants for food.

Mature toads may be found mating during the mating season when the eggs are being laid. These may be brought to school for further study. These may be kept for several days to study their structure, habits, and living responses.

The commercial value of the toad will interest the older pupils. Some important topics are "Why France Protects the Toad." "Toads in Cecelia Thaxter's Island Garden." "Toads as Pets."

What sounds are made by the toad? How does he shed his skin and what does he do with the old one? We have watched this operation of our aquarium toads.

Why is the toad classified as one of our beneficial animals?

Many life lessons can be learned from the little toad.

The tree-toad gives several fine examples of adaptability to environment. Compare his feet with the feet of the common garden toad.

Many interesting stories have been written about the toads, make a record of some of them. Have you had any interesting experiences with toads?

Toads make fine pets for a child. Why?

Why is a toad valuable if kept in a damp basement or cellar?

THE FROG.

Watching the development of the frog from the egg to the mature frog is an experience that no child should miss. Several times the boys have captured the mating frogs, brought them to school, and from the eggs laid, we have watched every change in the life process as far as visible.

As it requires several years for bull frogs to reach maturity, we cannot keep the ones hatched from the egg, but we can keep them from the egg (the bull frog eggs are laid in July) until the pollywog stage. We then secure some large pollywogs that are just ready to make the last metamorphosis and watch the change from a swimming, gill breathing animal into a forefooted, lung breathing animal.

Early in the spring, we secure eggs from the leopard frog and watch them, keeping exact record of all changes, to the pollywog stage. We secure some just ready for the last change and keep a record of all that happens.

The frog is a splendid animal to study as a type for comparisons. Its tadpole stage, its swimming stage, its power of regenerating a part of its tail, the absorption of the tail as the legs develop, the change from gills to lungs, changing its skin and power to hibernate from stored up fat bodies afford many points of attraction for interesting work.

SIGHT AND HEARING OF BIRDS.

Why does a hen cross the road in front of a moving automobile, then turn and run back again?

Is her field of vision the same as yours? Can she look at an object with both eyes at once?, What evidence can you find of the keen vision of birds. Watch a robin searching for food, can he see a worm where you cannot? Watch a buzzard, high in the air, when you see him drop, has he seen food from that distance? Can the hen wink her eyes? Has she lids like you have? She has a lid called a nictitating lid that she sometimes uses. Have you noticed this? Does it come up from below or down from above the eye? When you have chicken at home, examine the eyes for this lid. Take the eyes out very carefully and bring to school for study. Find the iris plates. Find the pecten in the eye if you can. Have you discovered different colors of birds' eyes?

Can you find the hen's ear? Can you find the bird's ear? What evidence that their hearing is keen?

Small birds are often heard calling to each other, during migration, probably for the purpose of keeping in touch with the ones that know the way.

Birds have a keen sense of direction, traveling at the high altitudes they do, they are able to pick up familiar landmarks far ahead. Their eyes are placed at the side of the head so they have a large panoramic field of vision. They have several organs in the eye that man does not have or has only as rudiments. For example, the nictitating

lid, used by the bird to protect the eye yet not wholly obscuring the vision. This third lid to the eye is easily seen. This membrane is elastic and by its own contractility is folded away from the eye when not needed. When the bird wishes to cleanse the eye from dust or other annoyances, it draws this membrane rapidly over the eye.

The eye of the bird is further remarkable for a series of plates which surround the pupil and are supposed to have a great influence in increasing or lessening the convexity of the eye ball. Another important structure is the pecten, a vascular, pigmented membrane, extending into the vitreous humor of the eye. The comb like teeth of the pecten are filled with blood and aid the bird in changing the focus of the eye rapidly.

What evidence can you give that a bird has the power to change the image in the eye very rapidly?

THE MOSQUITO

What proof can you give that a mosquito is an insect? Catch several and place in jar partly filled with water. Cover with mosquito net. Watch for egg or hatching wrigglers. These egg-rafts may often be found floating on the rain barrel and then placed in the covered jar. Watch for the hatching and study the larvae. How do they breath? At what angle do they rest? How do they swim? Watch the process through a hand lens and describe. What do they eat? Find the pupa resting at the top of the water head up in place of tail as in the larva and note the difference in structure from the larva stage.

Watch the mosquitoes emerge from the pupa and fly about in the jar. Learn from the government bulletins the difference between the Culex and Anopheles mosquitoes and identify yours to see whether it is the harmless or the malarial carrying species.

The male mosquitoes have feathery antennae so can be distinguished from the females.

Draw the various stages of the life history of the mosquito, labeling carefully.

Explain why oiling the breeding places kill the mosquitoes. What insects and birds are destroyers of mosquitoes?

Give various methods of extermination.

Read up on the great heroism of the men who discovered the relation of the mosquito to yellow fever.

OUR ENEMY, THE SAN JOSE SCALE.

Look on the leaves, new growth, or twigs of fruit trees or shrubs for the appearance of having been dusted with ashes. If twigs or other portions of the tree are found in this condition, bring to school for investigation.

Look to see if this is caused by a minute, circular scale about twice the thickness of a dime. If they are this size, ashy gray in color, and with a minute prominence near the center, San Jose scale may be suspected. Compare with San Jose scale in school collection, if there is one, if not, consult competent authority or kill and mail to State Agricultural college for identification.

Gather specimen twigs from all varieties of trees and shrubs infected, kill in boiling water and mount on chart.

Study amount of damage done in your locality.

Study life history. Make drawings of infected twigs and enlarge drawing of scales.

From Government bulletins and various other sources secure information concerning this destructive fruit pest and prepare report for class, and chart, to remain the property of the school, on the subject.

Investigate methods of control.

Referances on San Jose Scale.

Hodge - "Nature Study and Life" - pages 219-222

THE YELLOW-BILLED CUCKOO

This bird is better known as the "Rain-crow" because of the peculiar call it often gives and which many people think is a forecast of rain. There may be a certain atmospheric condition that causes this bird to give this call but I think the coming of rain has little to do with it, as I have frequently heard these birds calling for days and no rain came. Another superstition concerning these birds is that the cuckoo is a bird of evil omen, when in reality it is one of our most beneficial birds. It considers a web full of tent caterpillars a fine feast and has been known to devour a whole colony at one meal. Its stomach is often found thickly lined with the hair of these pests. We should appreciate it very much as it is about the only bird we have that will destroy these destructive insects.

These birds are plentiful and their beautiful love songs may be heard early and late. Their rich liquid notes rival many of our finest singers. Most people do not associate this beautiful singer with the bird that gives the "rain call."

The cuckoo is about the size of the mourning dove. The back is a brownish gray with an olive green gloss. The breast is much lighter. The wings are brown tipped with white. The tail is black on the upper side, tan below and tipped with white. The white tips of the tail feathers give the underside of the tail the appearance of being spotted and the long yellow bill and this long spotted tail makes this

easily identified.

It is not a very active bird and seldom makes long flights. It is very shy and always keeps on the opposite side of the tree from the observer. It uses its sharp eyes to detect its food on foliage and limb.

The nest is a rude platform of coarse twigs and grass, built low in bushes or on low spreading limbs, the haw tree seems to be a favorite. Several mothers often go together and build an "apartment house" nest to reduce the labor of house building.

THE HUMMINGBIRD.

Who has eyes sharp enough to find the hummingbird's nest? A wonderful little structure placed astride a limb and looking like a knot. Only three-fourths of an inch in diameter. Think of a bird's nest that size! This nest is built low at first, of soft wood, moss, lichens and scales from the tree on which it is found. To keep their enemies from finding their nests, the hummingbirds make them as inconspicuous as they can. How well they succeeded is proven by the fact that while we have many hummingbirds with us each summer, a nest is rarely found. In this beautifully constructed nest, the mother lays two, tiny white eggs no larger than a small bean. After the birdlings are hatched, the mother builds the nest up about the little ones until it is about one and one half inches high. The father bird never takes upon himself any home cares, seeming to think his beauty is excuse enough for being.

The young resemble the mother in plumage, and this accounts for our seeing so many more of these birds without the ruby throat than with it.

The mind of the boy and girl must be dull, indeed, that does not feel a response to the beauties of nature when this living, flashing jewel goes humming by or poises over a flower. Many people think this one of our wildest birds, but it is in fact one of our easiest to tame. If you wish to have these living gems flashing about your home, plant

plenty of red flowers, especially red sage, trumpet vine, coral honeysuckle, salvia or buckeye. You will see them poised many times a day, their small needle like bills entering the deep corollas, their long tongues sucking up the nectar while the tips sweep up the many insects.

The hummingbird's tongue is one of the most interesting tongues you can study. It is much longer than the bill, very slender, rolled up on each side, making a double tube and covered at the tip end with a little brush. It is commonly believed that the food of this bird consists chiefly of the nectar of flowers, but by examination of their stomachs it has been learned that their chief bill of fare is made up of insects. They have been seen to poise in front of a spider's web, devour all the insects and then eat the spider. They also catch insects on the wing.

It is one of our bravest birds, not fearing to attack any bird that crosses its path. It darts at them so swiftly and persistently that they soon retire.

They may be taught to eat from the hand and even from the lips. Celia Thaxter tells us they alighted on her arms while she worked in her "island garden." I kept one in my room for three weeks, one autumn. It flew about the flowers and fearlessly sipped the honey-water placed for it.

Notwithstanding their minute size, they are very beneficial because they destroy so many insects especially aphids, which is the chief food the mother gives her babies. They carry pollen for the flowers. The National Geographic

says:

"The more red flowers, the more humming birds and the more hummingbirds the more red flowers."

There are more than five hundred different species in the tropics but only one comes to us.

WHIP-POOR-WILL AND NIGHT HAWK.

I suppose many of you have heard that sad command, "Ship-poor-Will, Whip-poor-Will." How many of you have followed up the sound and made the acquaintance of him who made it? Every child likew to hear the call even though it does seem a little sad. If we listen closely when we hear several of these birds calling, just at dusk, we will notice that the different songs resemble each other in relation to tones, but that the key and time are often quite different.

These birds, so often heard, are seldom seen because of their wonderful protective coloration. When not on the wing, it usually squats on or near the ground, which it so closely resembles that we may pass near enough to step on it and not see it at all. Once I saw one squatting in the road and had to look very closely to distinguish it from the earth and pebbles as they looked so much alike. The night hawk and the whip-poor-will are each about the size of the robin but look larger because their feathers are more fluffy. The whip-poor-will which I saw in the road, did not move or stir, depending on its protective coloration, but it was easy to be seen by its bright eye and alert poise that it was ready to go if need be.

This bird flies along very quietly, in the dusk of evening, with a quick, darting movement, somewhat like that of the bat, for which it is often mistaken. As it darts here and there in search of mosquitoes, moths, beetles and other insects, you will have to look very closely to tell whether it is a bat or a whip-poor-will.

When flying you can easily distinguish it from its cousin, the night-hawk, if you will remember that its outer tail feathers are white, and that it has a white crescent on its throat, which appears to separate the short head from the body. The night hawk has a very distinct white bar across the wings and a white bar across the tail except the middle feather.

The whip-poor-will's head and beak are very short. The short beak makes up its size by being very wide. It literally stretches from ear to ear. It needs this kind of a mouth because it catches its food on the wing. It must have sharp eyes, quick movements, and a big mouth to catch the darting insects. To help entrap the insects, there are long, stiffened bristles at the corners of the mouth. The night hawk does ~~not~~ have these to assist it.

The feet and legs are so undeveloped that they plainly show they are but little used. They are not even used to grasp the limb in perching. They squat lengthwise on the limb to keep from falling.

The mother's eggs are as protectively colored as herself. They are laid on a carpet of leaves or on stones without any attempt to build a nest. The mother so closely resembles the place that it is very difficult to find her.

A bird frequently taken for the whip-poor-will is the nighthawk. It is seen sailing, skimming and swooping about in the early evening. As it flies it makes a very peculiar sound something like a squeal, then suddenly swoops down for

sixty or more feet, finishing the swoop with a loud booming sound like the sound of a big bass drum. The "boom" is made by the rush of the air through the wings just as they turn for the upward rise.

The boys call this bird the bull bat because the sound is somewhat like the "boom" of a bull frog or the bellow of a bull.

BIRD CHARACTERISTICS.

What does the high temperature of the bird indicate about its activity? It indicates the relation between the great quantity of food eaten to the size of the bird. The rapid metabolism because of intense activity.

Birds are very emotional creatures, as seen in their affection for their mates, in the great care bestowed on their young; and in their joyful moods, often bursting forth in song and even action. Several birds seem unable to tell all their joy through song as the king-bird that springs up and down from the highest branch of a tree; the mocking bird that often springs into the air while singing; and the yellow breasted chat that is called the "clown" because of his bounding performances in the air.

The distinguishing characteristics of birds are their covering of feathers, lack of teeth, power of flight, ability to walk on two feet, air sacs, partly marrowless bones with air spaces, horny beak, high blood temperature, scales on legs and musical sounds.

To aid in their flight we find the pectoral muscles highly developed. This muscle alone often weighing from one sixth to one fourth of the total weight. The body and head are shaped to overcome air resistance. The breast bone closely resembles the keel of a boat. The wings are attached high on the body. The bones of the back and pelvic arch grown together to give the wings stable support. The most of the weight is found in the lower part of the body like a

well balanced boat. This gives a comparatively low center of gravity which is of great value in balancing the body in the air. The bird's air sacs, nine in number, in the pigeon are placed high in the body to increase the bird's respiratory organs, aid in regulating body temperature, and help in flying.

By watching birds, one soon distinguishes many modes of flight, sailing or soaring with motionless wings, taking vertical strokes to rise, and oblique strokes to move forward. Soaring is but little understood. It is supposed by some that the bird is floating between two oppositely moving currents of air.

The movements of birds through the air seems to me to be more like the swimming motions. The air resistance is very slight, except when flying rapidly.

Ruskin describes the flight of birds as follows:

Sail; air strikes sail

Bird; wings strike air, downward stroke carried
bird up, oblique strokes carries bird forward.

The colors of birds in relation to habitat, their changes during the mating season and afterward, the various ways of moulting and migration are interesting topics for study.

COCKROACHES.

Collect cockroaches from warm, moist places in many business buildings, in apartment houses and in cellars.

If in a region where they are found, watch for them and find their hiding places, study their general habits. At night, turn on the light and see them scatter. Find the various stages of growth and the large adults. Look for the female carrying her egg case. Compare the cockroaches with other insects. What characteristics do you find that permits them to escape from their enemies? What enemies do you know that the cockroach must escape from? Do you believe the wings will aid the cockroach to any great extent? What differences do you find between the young and the adults? What is the food of the cockroach? Capture a number and place in jar (glass) with bread, apple, potato, or other food and watch to see them eat. Describe the process. Describe their mouth.

Are they harmful or beneficial to man? How can they be exterminated?

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